NC STATE UNIVERSITY

2022-2023 GRADUATE CATALOG

Table of Contents

North Carolina State University

Welcome to North Carolina State University!

About the Catalog

This catalog showcases all of the programs and plans offered at our university, from undergraduate baccalaureate degrees, to the Doctor of Veterinary Medicine.

The Undergraduate Catalog (http://catalog.ncsu.edu/undergraduate/) houses important information on academic policies for student success, undergraduate admission and readmission information, and different ways you can be involved on during your undergraduate career at NC State.

The Graduate Catalog (p. 66) hosts a wealth of information on paths to your degree, career and research opportunities, and the NC State Graduate School Handbook.

Learn about all of the student activities (p. 45) available to the Wolfpack, exceptional services (p. 51) offered to all students, and other important resources (p. 36) that we're proud to provide.

Check out the Course Descriptions (p. 969) to see every course option being offered for the 2020-2021 academic year, and view the new dynamic Course Search (http://catalog.ncsu.edu/course-search/) to search courses by subject or keyword.

We're happy you're here, and we can't wait to show you all that NC State University has to offer. What are you waiting for?

About Us

North Carolina State University (https://www.ncsu.edu/) (NC State) began as a land-grant institution grounded in agriculture and engineering. Today, we're building a leading public research university that excels across disciplines.

NC State is a powerhouse in science, technology, engineering and math. We lead in agriculture, education, textiles, business and natural resources. We're at the forefront of teaching and research in design, the humanities and the social sciences. And we're home to one of the planet's best colleges of veterinary medicine.

Our more than 36,000 undergraduate and graduate students learn by doing. They pursue research and start new companies. They forge connections with top employers and serve local and global communities. And they enjoy an outstanding return on investment.

Introduction

Founded March 7, 1887 by the North Carolina General Assembly under the provisions of the national Land-Grant Act, North Carolina State University is now one of the nation's preeminent research institutions and the university of choice for accomplished, high-performing students from around the world.

NC State's extensive public and private partnerships create a unique culture of collaboration to address the grand challenges facing society. The university's solution-driven research, technology and scholarship lead to new ideas, products and services. It's no wonder NC State is know for its forward-looking philosophy: Think and Do.

With more than 35,000 students and 8,000 faculty and staff, NC State is a comprehensive university known for its leadership in interdisciplinary innovation. As a leader in experiential education, NC State provides remarkable opportunities for students to put learning into practice and to develop career-ready skills.

The university is consistently ranked as a top-tier university by *U.S. News & World Repor*t and is regularly named by Kiplinger's as a top-10 best value in public higher education, a ranking that combines academic quality and affordability. Because of this value, NC State students graduate with lower-than-average debt, according to *U.S. News*.

Beginning their freshman year, NC State students are able to explore their major right away — by conducting research alongside faculty or starting a challenging co-op or internship. NC State has a large and diverse student population with the feel of a tight-knit community.

NC State is located in the Research Triangle region, home to many of the country’s leading Fortune 500 technology, research and pharmaceutical companies. NC State’s Centennial Campus is home to more than 150 corporate and government research partners, incubator companies and NC State research units.

Mission, Vision and Values

Mission

As a research-extensive land-grant university, North Carolina State University is dedicated to excellent teaching, the creation and application of knowledge, and engagement with public and private partners. By uniting our strength in science and technology with a commitment to excellence in a comprehensive range of disciplines, NC State promotes an integrated approach to problem solving that transforms lives and provides leadership for social, economic, and technological development across North Carolina and around the world.

Vision

NC State University will emerge as a preeminent technological research university recognized around the globe for its innovative education and research addressing the grand challenges of society.

Values

Consonant with our history, mission, and vision, North Carolina State University affirms these core values:

- Integrity—in the pursuit, creation, application, and dissemination of knowledge
- Freedom—of thought and expression
- Respect—for cultural and intellectual diversity
- Responsibility—for individual actions and service to society
- Stewardship—in sustaining economic and natural resources
- Excellence—in all endeavors

History

Founded March 7, 1887 by the North Carolina General Assembly, the school--then known as the North Carolina College of Agriculture and Mechanic Arts--embodied ideals that were rapidly transforming the field of higher education. Chief among them was the belief that colleges should not be reserved for a select few and that the children of farmers, mechanics and other workers should have access to the opportunities and benefits of higher education.

NC State was established under the provisions of the Morrill Act of 1862, which allowed the U.S. government to donate federally owned land to the states for the purpose of establishing colleges that would teach “agriculture and the mechanic arts.” The brand-new school held its first classes in the fall of 1889 with 72 students, six faculty members and one building. In the early 1900s, a new federal program sparked an era of outreach work at the college. The 1914 passage of the Smith-Lever Act created an educational partnership between land-grant colleges and the U.S. Department of Agriculture. Under this new cooperative extension program, the colleges would send staff to meet with farmers around the state and provide practical agricultural instruction. This led North Carolina to establish the Cooperative Agricultural Extension Service (now the North Carolina Cooperative Extension Service (http://www.ces.ncsu.edu/)) at NC State.

By the 1920s, North Carolina State College (as the school was then known) was beginning to grow beyond its original agricultural and mechanical focus, adding schools of engineering, textiles, education and business, as well as a graduate school. The Depression posed economic challenges for higher education throughout the nation, and State College was no exception. As the crisis slowly eased, the college renewed its growth, adding students and developing new programs until the onset of World War II. State College contributed to the war effort by hosting a number of military detachments and training exercises and by refitting the work of several departments and programs to military and defense purposes.

The campus experienced unparalleled growth during the postwar years as the G.I. Bill brought thousands of former servicemen to campus. In the following decades, the college continued to expand its curricula, creating schools of design, forestry, physical and mathematical sciences,

and humanities and social sciences. During these years of growth, the name was changed again, this time to North Carolina State University at Raleigh—the university's current official name.

The university celebrated its 100th anniversary in 1987, which also saw the creation of Centennial Campus (http://centennial.ncsu.edu/), bringing together academic, corporate, government and nonprofit leaders to partner in teaching, research and economic development.

NC State has developed into a vital educational and economic resource, with more than 34,000 students and 8,000 faculty and staff. A wealth of university outreach and extension programs continue to provide services and education to all sectors of the state's economy and its citizens. Consistently ranked a best value (http://www.kiplinger.com/tools/colleges/school.php?id=7794) among the nation's public universities, NC State — the state's largest university — is an active, vital part of North Carolina life. Today, more than 128 years after its founding, NC State continues to follow its original mission: opening the doors of higher education to the citizens of North Carolina and providing teaching, research and extension that strengthen the state and its economy.

Campus

NC State University is located west of downtown Raleigh on 2,099 acres. The campus acreage includes Centennial Campus on 1,105 acres and Centennial Biomedical Campus on 215 acres. West Campus includes the College of Veterinary Medicine and the stadium/arena complex. Nearby are research farms, biology and ecology sites, horticulture and floriculture nurseries and research forests that cover an additional 3,000 acres. Elsewhere across the state are research farms and 4-H camps.

Research Triangle Park

NC State is one of three nationally renowned research universities in the Triangle area, along with Duke University in Durham and the University of North Carolina at Chapel Hill. Within the 30 mile triangle formed by the three universities is Research Triangle Park, a 7,000-acre research park founded in 1959 by leaders in academia, business and government. Today, Research Triangle Park is home to some of the most innovative technology and research-based companies in the world.

Faculty

The university has 9,553 employees, including 2,360 faculty. Among the many honors and recognitions received by members of the faculty are 9 memberships in the National Academy of Sciences, 18 memberships in the National Academy of Engineering, one membership in the Institute of Medicine, and 778 members of NC State's Academy of Outstanding Teachers.

Students

In the 2021 Fall Semester, the university's head count enrollment totaled 37,555. Included in this number were 25,8189 students in undergraduate degree programs, 9,394 in graduate degree programs, 397 First Professional and 2,069 non- degree-seeking students. The total enrollments by college were:

- Agriculture and Life Sciences - 3,937
- Design - 924
- Education - 1,957
- Engineering - 10,269
- Natural Resources - 2,104
- Humanities and Social Sciences - 4,693
- Management - 4,556
- Sciences - 4,113
- Textiles - 1,001
- Veterinary Medicine - 488
- University College - 1,218
- Other- 1,710

The student population included 2,401 Black or African American students, 2,417 Hispanic students, 2,996 Asian, American Indian and Pacific Islander students, and 1,405 students identifying as two or more races. The fall 2021 class also included 18,552 female students. Students at the university come from 53 U.S. states and territories (including District of Columbia) and 116 foreign countries. The international enrollment is a distinctive feature of the institution as 3,913 international students give the campus a cosmopolitan atmosphere.

Outreach and Extension

As North Carolina's flagship research intensive, community engaged land-grant university, NC State has a unique mission to serve the citizens of this state through technical assistance, professional development, lifelong education, technology transfer, and other means of applying knowledge to real world issues and problems. Faculty, students, and staff from all ten academic colleges and other units engage in collaborative research, learning, and service partnerships with business, industry, government, and communities, in the Triangle region and across the state. Extension and engagement imperatives include economic development, environmental stewardship, K-12 education, leadership development, and entrepreneur support. NC State's Office of Extension, Engagement, and Economic Development reaches over one million citizens annually through Cooperative Extension, Industrial Extension, McKimmon Center for Extension and Continuing Education, NC State's Economic Development Partnership, the General Hugh Shelton Leadership Center, and the North Carolina Small Business and Technology Development Center.

Administration

NC State is one of 16 constituent institutions of the multi-campus University of North Carolina system (http://www.northcarolina.edu/). The UNC Board of Governors is the policy-making body legally charged with "the general determination, control, supervision, management, and governance of all affairs, of the constituent institutions."

North Carolina State University is accredited by the Southern Association of Colleges and Schools Commission on Colleges (https://www.sacscoc.org/) to award associate, baccalaureate, master's, and doctoral degrees. Questions about the accreditation of North Carolina State University may be directed in writing to:

Southern Association of Colleges and Schools Commission on Colleges
1866 Southern Lane
Decatur, Georgia, 30033-4097

Or by calling (404) 679-4500, or by using the information available on SACSCOC's website (https://www.sacscoc.org/).

Normal inquiries about NC State, such as admission requirements, financial aid, educational programs, etc., should be addressed directly to the university and not the Commission's office.

Executive Officers (https://leadership.ncsu.edu/)

Board of Trustees (https://leadership.ncsu.edu/board-of-trustees/)
UNC Board of Governors (http://www.northcarolina.edu/apps/bog/members.htm)

University Administration

Office of the Chancellor

W. Randolph Woodson, *Chancellor*

Paula Gentius, *Chief of Staff and Secretary of the University*

Lindsay Recchie, *Assistant to the Chancellor*

Maggie Thompson, *Chancellor's Communications Specialist*

Charisse Rogers, *Assistant to the Chief of Staff*

Lisa Pierson, *Business Officer*

Office of the Executive Vice Chancellor and Provost

Warwick A. Arden, *Executive Vice Chancellor and Provost*

Dr. Mark Bernahard, *Vice Provost for Continuing Education*

Dr. Kwesi Brookins, *Interim Vice Provost for Outreach and Engagement, Director, Center for Family and Community Engagement*

Dr. Fashaad Crawford, *Vice Provost for Assessment and Accreditation*

Adrian Day, *Vice Provost for Business Operations and Strategic Resource Management*

Dr. Rob Dunn, *Interim Senior Vice Provost for University Interdisciplinary Programs*

Dr. Don Hunt, *Senior Vice Provost for Enrollment Management and Services*

Dr. Bailian Li, *Senior Vice Provost for Global Engagement*

Dr. Thomas K. Miller, *Senior Vice Provost for Entrepreneurship*

Dr. Margery Overton, *Senior Vice Provost for Institutional Strategy and Analysis*

Dr. Donna Petherbridge, *Vice Provost for DELTA*

Greg Raschke, *Senior Vice Provost and Director of Libraries*

Sheri Schwab, *Vice Provost for Institutional Equity and Diversity*

Dr. Katharine Stewart, *Senior Vice Provost for Faculty and Academic Affairs*

Dr. Courtney Thornton, *Interim Senior Vice Provost for Instructional Programs*

Chancellor's Cabinet

Warwick Arden, *Executive Vice Chancellor and Provost*

Brad Bohlander, *Chief Communications Officer, Associate Vice Chancellor of University Communications*

Boo Corrigan, *Director of Athletics*

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Paula Gentius, *Chief of Staff and Secretary of the University*

Marc I. Hoit, *Vice Chancellor for Information Technology*

Kevin Howell, *Vice Chancellor for External Affairs, Partnerships and Economic Development*

Charles Maimone, *Vice Chancellor for Finance and Administration*

Allison Newhart, *Vice Chancellor and General Counsel*

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Doneka Scott, *Vice Chancellor and Dean for the Division of Academic and Student Affairs*

Brian Sischo, *Vice Chancellor for University Advancement*

Mladen Vouk, *Vice Chancellor for Research and Innovation*

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Dr. Deanna Dannels, *College of Humanities and Social Sciences*

Dr. John Dole, *Interim Dean, College of Agriculture and Life Sciences*

Dr. Myron Floyd, *College of Natural Resources*

Dr. Peter Harries, *The Graduate School*

Dr. David Hinks, *Wilson College of Textiles*

Dr. Mark Hoversten, *College of Design*

Dr. Louis Martin-Vega, *College of Engineering*

Dr. Christine McGahan, *College of Sciences*

Dr. Kathryn Meurs, *Randall B. Terry, Jr. Dean, College of Veterinary Medicine*

Dr. Doneka Scott, *University College, Division of Academic and Student Affairs*

Dr. Paola Sztajn, *Dean, College of Education*

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The University Council is also composed of the chancellor's cabinet and the deans of the colleges.

UNC System Administration

University of North Carolina System Board of Governors

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Wendy Floyd Murphy, *Vice Chair*

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J. Alex Mitchell

Anna Spangler Nelson

Sonja Phillips Nichols

Raymond Palma

Art Pope

David Powers

Lee Roberts

Temple Sloan

Michael Williford

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Bart Goodson, *Senior Vice President of Government Relations*

Thomas Walker, *Senior Advisor for Economic Development and Military Affairs*

Academic Calendar

Fall 2022 Semester

Date(s)	Day(s)	Description
August 22	Monday	First day of classes
September 5	Monday	Labor Day - No Classes, University Closed
October 10 - 11	Mon - Tue	Fall Break - No Classes
November 23	Wednesday	Thanksgiving Break - No classes
November 24 - 25	Thur - Fri	Thanksgiving Holiday - No Classes, University Closed
December 5	Monday	Last day of classes
December 6 - 7	Tue - Wed	Reading Days
December 8 - 14	Thur - Wed	Final examinations
December 17	Friday	Fall Commencement Exercises
December 23 - 30	Fri - Fri	Winter Break

Fall 2022 8-Week Sessions

Date(s)	Day(s)	Description
August 22	Monday	First day of classes (First 8-Week Session)
October 13	Thursday	Last day of classes (First 8-Week Session)
October 14	Friday	First day of classes (Second 8-Week Session)
December 5	Monday	Last day of classes (Second 8-Week Session)

Spring 2023 Semester

Date(s)	Day(s)	Description
January 9	Monday	First day of classes
January 16	Monday	Martin Luther King Jr. Day - No Classes, University Closed
March 13 - 17	Mon - Fri	Spring Break - No Classes
April 24	Monday	Last day of classes
April 25 - 26	Tue - Wed	Reading Days
April 27 - May 3	Thur - Wed	Final examinations
May 6	Saturday	Spring Commencement Exercises

Spring 2023 8-Week Sessions

Date(s)	Day(s)	Description
January 9	Monday	First day of classes (First 8-Week Session)
February 28	Tuesday	Last day of classes (First 8-Week Session)
March 1	Wednesday	First day of classes (Second 8-Week Session)
April 24	Monday	Last day of classes (Second 8-Week Session)

Summer 2023 Session I

5-Week Session I

Date(s)	Day(s)	Description
May 17	Wednesday	First day of classes
May 29	Monday	Memorial Day- No Classes, University Closed
June 19	Monday	Juneteenth - No Classes
June 21	Wednesday	Last day of classes (5-Week Session I)
June 22 - 23	Thur - Fri	Final examinations

"Maymester" 3-Week Session

Date(s)	Day(s)	Description
May 17	Wednesday	First day of classes
May 29	Monday	Memorial Day- No Classes, University Closed
June 7	Wednesday	Last day of classes

10-Week Session

Date(s)	Day(s)	Description
May 17	Wednesday	First day of classes
May 29	Monday	Memorial Day- No Classes, University Closed
June 19	Monday	Juneteenth - No Classes
June 22 - 23	Thur - Fri	No Classes
July 4	Tuesday	Independence Day - No Classes, University Closed
July 28	Friday	Last day of classes
July 31 - August 1	Mon - Tue	Final examinations

Summer 2023 Session II

5-Week Session II

Date(s)	Day(s)	Description
June 26	Monday	First day of classes
July 4	Tuesday	Independence Day - No Classes, University Closed

July 28	Friday	Last day of classes
July 31 - August 1	Mon - Tue	Final examinations

Note: Dates in this publication are those that have been approved by appropriate agencies of the university at the time of publication. Changes may be announced in official university publications subsequent to this publication and maintained on the S (http://www.ncsu.edu/registrar/calendars/)tudent Services Center website (https://go.ncsu.edu/academiccalendar/).

Admission and Enrollment

View the following links for helpful information about the various paths to admission to NC State, enrollment options and procedures, financial aid eligibility, and university tuition and fees.

Admission

What best describes the type of student you are? Are you looking to attend NC State for one of our outstanding undergraduate baccalaureate degree programs? Are you thinking about pursing your doctoral degree here? Or, do you want to explore some of our course offerings as a Non-Degree Studies student? Check out the links below to view admissions requirements and procedures based on your academic history, needs and goals.

Undergraduate Admission

NC State is a member of the Common Application (http://www.commonapp.org/) and the Coalition for Access, Affordability, and Success (http://www.coalitionforcollegeaccess.org/). Students may choose to apply through either application system. Undergraduate Admissions implements a notification date system for both domestic freshman and transfer applicants. International applicants are notified of their admission decision on a rolling basis once their application is complete. Freshmen are strongly encouraged to apply during the fall of their senior year in high school by the early action deadline.

Application Dates and Deadlines (https://admissions.ncsu.edu/apply/dates-and-deadlines/)

Freshman and transfer applicants for the College of Design and Fashion and Textile Design program must submit a complete application including a portfolio and additional essay by November 1 and list it as their first choice major.

All applications for the spring semester should be submitted prior to October 1. A few programs do not accept applications for spring entry including applied mathematics and mathematics, College of Design studio-based majors, College of Engineering, Exploratory Studies, fashion and textile design, physics and statistics.

Students are notified of their decision on their wolfPAW account (https://wolfpaw.ncsu.edu/Default.asp) and admitted students (https://admissions.ncsu.edu/enroll/) must confirm their enrollment by May 1, or within ten days of if they are accepted after May 1.

The Undergraduate Admissions website (http://admissions.ncsu.edu/) provides more information on the application review process and procedure.

Office of Undergraduate Admissions
NC State University
121 Peele Hall
Campus Box 7103
10 Watauga Club Drive
Raleigh, NC 2707
Phone: 919-515-2434
Email: undergrad-admissions@ncsu.edu

Jon Westover, Associate Vice Provost and Director of Undergraduate Admissions

Admission to the university is highly competitive. Applicants are asked to indicate their first and second choices for a curriculum, including undeclared majors within a college, or, if undecided, to indicate their choice of participating in University College Exploratory Studies. Applicants not admitted in their first curriculum choice will be reviewed for admission in their second curriculum choice. The admissions decision is based on a holistic review of a complete application. Of primary importance is the high school record, including the level and difficulty of the courses taken, the overall grade point average, rank in class, and scores on the SAT or the ACT. Extracurricular involvement, leadership, and many other factors are also considered.

Admissions Requirements

The Board of Governors of the University of North Carolina System has determined that the Minimum Course Requirements (MCR) for all constituent institutions, including NC State, shall include a high school diploma or its equivalent and the following course units taken in high school:

1. Six course units in language, including
   - Four units in English
   - Two units in a language other than English
2. Four course units of mathematics in any of the following combinations:
   - Algebra I and II, Geometry, and one unit beyond Algebra II
   - Algebra I and II, and two units beyond Algebra II or
   - Integrated Math I, II, III and one unit beyond Integrated Math III
3. Three course units in science, including
   - At least one unit in a life or biological science, and
   - At least one unit in physical science, and
   - At least one laboratory course
4. Two course units in social studies, including
   - One unit in U.S. history
   - One other unit in social studies

Competitive applicants will typically exceed these minimum courses. It is recommended that every student take a foreign language course and a mathematics course in their senior year.

NC State does not conduct individual interviews with applicants, however, students are always welcome to walk-in and meet with an admissions officer at NC State's Joyner Visitor Center. Information sessions and

student led campus tours are also available Monday through Friday at the Joyner Visitor Center (http://admissions.ncsu.edu/visit/schedule-your-visit/).

How to Apply

1. Review our deadlines: The application opens in August
2. Complete the application through the Common App or the Coalition App; we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
3. Pay the $85 application fee, or provide an official fee waiver.
4. Self-report your test scores. Visit our website (https://admissions.ncsu.edu/apply/freshmen/application-process/) for more information and for our school codes.
5. Submit your official academic transcript.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines

Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Early Action:

- Deadline: November 1
- Notification Date: January 30

Fall Entry Regular Decision:

- Deadline: January 15
- Notification Date: March 30

Spring Entry Regular Decision:

- Deadline: October 1
- Notification Date: December 1

Some programs do not accept applications for spring entry. Visit our website for details.

Studio-Based Majors

The following programs are considered studio-based majors and are fall entry only:

- Architecture
- Art & Design
- Fashion & Textile Design
- Graphic Design
- Industrial Design

Application Deadline: November 1

Portfolio and Optional Essay Due: November 1

Agricultural Institute

NC State's 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:

- Deadline: June 1
- Decision Date: Rolling

Spring Entry:

- Deadline: November 1
- Decision Date: Rolling

Credit Opportunities

Students can jump-start their college careers by acquiring pre-enrollment credits by one or more of the following means:

1. by passing a proficiency examination administered by a teaching department at NC State;
2. by meeting a specific minimum score on certain Advance Placement Program (AP), International Baccalaureate (IB) examinations, and/or A and AS Level Equivalencies; and/or
3. by attaining a minimum score on certain College Level Examination Program (CLEP) subject tests.

Learn about the recognized test curriculum, accepted test scores and credit awarded at admissions.ncsu.edu/apply/credit-opportunities (http://admissions.ncsu.edu/apply/credit-opportunities/).

Out-of-State Students

Undergraduate applicants from outside North Carolina are reviewed using the same criteria as applicants from North Carolina. NC State is limited to enrolling not more than 18 percent of total new undergraduate students from outside the state as set forth by the University of North Carolina System.

The path to NC State is not always direct. About 20 percent of our students start their college career at another college or university. All transfer applicants should have at least 30 transferable college credit hours completed, including specific coursework and a competitive GPA based on the major you are applying for. Meeting these recommendations does not guarantee admission but sets you up to be considered a competitive applicant in the review process. View our recommendations for competitive applicants (https://admissions.ncsu.edu/apply/transfers/application-review/#recommendations-for-competitive-applicants).

What We Look For

Here are some of the items we're looking at when evaluating your transfer application to NC State:

1. Your college coursework and GPA
2. Your high school coursework and test scores if you have less than 30 transferable college semester credit hours completed
3. Your interest in the program you're applying for
4. Your accomplishments/involvement outside of the classroom
5. Your background and opportunities
6. Your individual story

Visit our Transfer Admissions website (https://admissions.ncsu.edu/apply/transfers/application-review/) for more information and recommendations for competitive transfer applicants.tudents are always welcome to walk-in and meet with an admissions officer at NC State's Joyner Visitor Center. Information sessions and student led campus tours are also

available Monday through Friday at the Joyner Visitor Center (http://admissions.ncsu.edu/visit/schedule-your-visit/).

How to Apply

1. Review our deadlines: The application opens in August. Be sure to pay attention to additional requirements and timelines for Studio-Based Majors and the Agricultural Institute.
2. Plan your path, and review our recommendations for competitive applicants.
3. Complete the application through the Common App (http://www.commonapp.org/) or the Coalition App (http://www.coalitionforcollegeaccess.org/); we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
4. Pay the application fee or provide an official fee waiver.
5. Submit your official academic transcript(s) from each institution you have attended.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines

Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Regular Decision:

- Deadline: January 15
- Notification Date: March 30

Spring Entry Regular Decision:

- Deadline: October 1
- Notification Date: December 1

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The following programs are considered studio-based majors and are fall entry only:

- Architecture
- Art & Design
- Fashion & Textile Design
- Graphic Design
- Industrial Design

Application Deadline: November 1

Portfolio and Optional Essay Due: November 1

Agricultural Institute

NC State's 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:

- Deadline: June 1
- Decision Date: Rolling

Spring Entry:

- Deadline: November 1
- Decision Date: Rolling

Transfer Credit

Search our transfer course equivalency database (https://webappprd.acs.ncsu.edu/php/transfer/) to get an initial idea of which course credits from other institutions transfer to NC State. An official course evaluation is provided to students once they are admitted.

Visit Us

Transfer Admissions Center
Joyner Visitor Center
1210 Varsity Drive
Raleigh, NC 27607
Phone: 919-513-1200

At NC State we value diversity and welcome international students. Located in Raleigh, North Carolina, we are proud to be home to the most diverse student body in North Carolina hosting students from 117 different countries.

The Office of International Services (https://internationalservices.ncsu.edu/future-students/) is the main resource for international students regarding immigration regulations, university policies, employment and travel. They provide assistance to you and your family as you prepare to arrive on campus and to smooth the transition to studying in the U.S.

What We Look For

Here are some of the items we're looking at when evaluating your transfer application to NC State:

1. Your Academic Achievement
2. Your financial ability: If you require an F-1 or J-1 student visa to study in the U.S., you must prove your ability to cover the estimated school expenses by completing the Certificate of Financial Responsibility (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2017/07/2018-CFR.pdf).
3. Your level of English language skills
4. Your interest in the program you are applying for
5. Your accomplishments/involvement outside the classroom
6. Your background and opportunities
7. Your individual story

Visit our International Admissions website (https://admissions.ncsu.edu/apply/international/) for more information on application considerations, including interactive interviews (for Chinese applicants) and SAT or ACT composite scores (for Freshman applicants only).

How to Apply

Visit our website to view the following information in the following languages: Spanish (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2019/10/Spanish-Translation-2019-2020.pdf), Korean (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2019/10/

Korean-Translation-2019-2020.pdf), Mandarin (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2019/10/Mandarin-Translation-2019-2020.pdf), Portuguese (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2019/10/Portuguese-Translation-2019-2020.pdf) and Arabic (https://admissions.ncsu.edu/wp-content/uploads/sites/8/2019/10/Arabic-Translation-2019-2020.pdf).

1. Review our deadlines: The application opens in August. Be sure to pay attention to additional requirements and timelines for Studio-Based Majors and the Agricultural Institute.
2. Complete the application through the Common App (http://www.commonapp.org/) or the Coalition App (http://www.coalitionforcollegeaccess.org/); we do not have a preference. Applicants for Studio-Based Majors will also need to submit a portfolio.
3. Pay the application fee ($100 for international applicants).
4. Submit your academic credentials. Visit our website for details.
5. Show proof of English proficiency (https://admissions.ncsu.edu/apply/international/international-application-review/), if you are not from a country where English is the official or commonly spoken language.
6. Check your status in your wolfPAW (https://apply.ncsu.edu/portal/wolfpaw/) account throughout the application process.

Admissions Dates and Deadlines

Decisions are released on the corresponding notification date as long as the application is complete by the deadline.

Fall Entry Early Action:

- Deadline: November 1
- Notification Date: January 30

Fall Entry Regular Decision:

- Deadline: January 15
- Notification Date: March 30

International applicants must apply by the deadline and will have their admissions decisions released on a rolling basis once your application is complete.

Spring Entry Regular Decision:

- Deadline: October 1
- Notification Date: December 1

Some programs do not accept applications for spring entry. Visit our website for details.

Studio-Based Majors

The following programs are considered studio-based majors and are fall entry only:

- Architecture
- Art & Design
- Fashion & Textile Design
- Graphic Design
- Industrial Design

Application Deadline: November 1

Portfolio and Optional Essay Due: November 1

Agricultural Institute

NC State's 2-year Agricultural Institute (AGI) (http://catalog.ncsu.edu/undergraduate/agriculture-life-sciences/agricultural-institute/) accepts freshman and transfer applicants.

Fall Entry:

- Deadline: June 1
- Decision Date: Rolling

Spring Entry:

- Deadline: November 1
- Decision Date: Rolling

Use of Agents or Educational Agencies

NC State does not partner with incentive-based agents or educational agencies to represent the University or to administer any part of the application process.

We recognize that in many countries agents or consultants are retained by students and their families to assist in applying to universities in the United States. It is not necessary to engage an agent in order to have a strong chance of admission to NC State. Admission decisions are not based on the recommendations of agents.

NC State expects an application to be the work of the applicant and that all information on the application is complete, accurate and truthful. We may reject application materials, cancel an admissions offer or dismiss a student from attendance, if it is determined that application materials have been falsified.

It is critical that applicants use their own email address, phone number, and mailing address on their application to ensure that all communication from NC State is delivered in an accurate and timely manner. Missing any important communication from NC State may delay applicants' application process and admission decisions.

Financial and Immigration Information

All international applicants seeking an F-1 or J-1 student visa must submit a Certificate of Financial Responsibility (CFR) as part of the admission process. The purpose of this form is to certify financial solvency for the student throughout his/her program of study - this is a federal requirement that must be met before the Office of Undergraduate Admissions can issue any visa certificates.

In addition, applicants deemed admissible who are already in the U.S. must also fill out a Visa Clearance Form (VCF). This includes international applicants who are in a nonimmigrant visa category other than F-1 or J-1 (ex: H-4, L-2, DACA, E-2, Pending Permanent resident etc.). These applicants are not required to complete a CFR, unless they plan to change to F-1 or J-1 student status (if eligible).

CFR and VCF forms are reviewed by the Office of Undergraduate Admissions upon receipt. If the information provided by the applicant is incomplete or not acceptable (e.g. sponsor and bank official signatures, bank statements, etc.), the applicant will be notified that his/her documents were not approved and why. Notification is done via e-mail. The applicant will then have an opportunity to correct the problem(s) and

resubmit the form(s). Applicants can check the status of their applications through their WolfPAW account.

Once the applicant is considered admitted (fully or conditionally) to the University, the Office of Undergraduate Admissions mails out the appropriate Certificate of Eligibility (Form I-20 for an F-1 visa or Form DS-2019 for a J-1 visa) along with the full admission letter and other important pre-arrival information. Newly fully admitted international students will also receive information and guidance from the Office of International Services (OIS) via email prior to their arrival to NC State. Conditionally admitted international students will received information from the Intensive English Program (IEP) prior to their arrival as well.

New F-1 and J-1 international students must check-in with the Office of International Services upon arrival to campus and attend the New International Student Orientation, which is scheduled a few days before the semester begins.

New international students who are accepted to NC State have the opportunity to participate in a Summer Start program during the month of July before fall classes begin. More information can be found here. https://newstudents.dasa.ncsu.edu/summerstart/

Contact Us

Office of Undergraduate Admissions
Jeong Powell
Director, International Admissions and Recruitment
Phone: 919-515-2434
Email: jcpowell@ncsu.edu

Graduate Admission

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

The Graduate School is committed to provide a transformative experience for graduate students and postdoctoral researchers at NC State by preparing these talented individuals to become true leaders ready to tackle the major challenges facing our state, nation, and world. NC State is recognized as a national leader in the STEM disciplines, and the University supports advanced study and innovative research in numerous fields, including agriculture, life sciences, design, education, engineering, natural resources, humanities and social sciences, management, textiles, and veterinary medicine, along with many exciting interdisciplinary programs.

NC State currently offers over 160 master's programs and more than 60 doctoral programs in both traditional and emerging disciplines, including biomedical engineering, biotechnology, genomics, geographical information systems, nanotechnology, and natural resources. The University also offers a broad range of certificate programs that afford graduate students and postdoctoral scholars with opportunities to collect certification for key skills and knowledge. Moreover, several Professional Science Master's programs are offered that tailor educational outcomes to employer needs.

The Graduate School also proudly offers numerous professional development experiences throughout the year. These opportunities are meant to endow graduate students and postdoctoral scholars with a competitive edge that enhances their ability to land jobs and to experience long-term career success. Graduate School professional development programming incorporates training that pertains to four core competency areas: professional and personal development, leadership and management, academic development, and communication. Signature programs include the Notes From the Field seminar series, the Transition to Industry Immersion Program, the Dissertation and Thesis Institute, the Teaching and Communication Certificate program, the Preparing Future Faculty program, the STEM Faculty Launch program, the Team Case Studies course, and the Job Search Strategies course.

The criteria used for admissions decisions vary according to programs and schools/colleges, reflect an evaluation of the applicant's potential for graduate work, and consider the ability of a program to accommodate additional students. Commonly, departmental admissions committees consider requests for admission and forward their recommendations to the Graduate School. However, Graduate School regulations govern the criteria for the classification of graduate student status.

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware of specific program deadlines (https://grad.ncsu.edu/programs/), as many are earlier than the Graduate School priority deadlines. All application fees are totally non-refundable. *Note that applications must be submitted to the Graduate School by midnight Eastern Standard Time on the deadline.*

The Graduate School (https://grad.ncsu.edu/)
1020 Main Campus Drive, Box 7102
Raleigh, NC 27695

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

Application Checklist

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware that many program deadlines are **earlier** than the Graduate School priority deadlines.

- Unofficial transcripts from all colleges and universities previously attended
  - If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  - All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  - Official transcripts and statements of degree will be required if you are recommended for admission
- 3 Recommendations from people who know your academic record and potential for graduate study
  - All recommendation letters are submitted online through a link that will be sent to each recommender's email once their information is listed on the recommendation list
- Standardized Test Scores
  - Depending on the prospective program's admission requirements, this may include: GRE, GMAT, and/or MAT scores
- Statement of Purpose & CV/Resume
- Supplemental Documentation
  - Depending on the prospective program's admission requirements, this may include: research papers, additional essay questions, or writing/media samples
- Application Fee

- Domestic Application: $75.00
- Graduate Certificate Application: $25.00
- Payments are made online as the last step of the Admissions application through any major credit card issuer
- **All application fee submissions are totally non-refundable**

For a list of graduate degrees, details on the programs, and admissions information, please consult the Graduate Programs website (https://grad.ncsu.edu/programs/).

Application Checklist

Applications and all supporting documents must be received on or before the priority deadlines OR the Program Deadlines (https://grad.ncsu.edu/programs/), whichever is earlier. Please be aware that many program deadlines are **earlier** than the Graduate School priority deadlines.

- Unofficial transcripts from all colleges and universities previously attended
  - If you are currently enrolled in an institution taking courses, you will need to provide a list of courses in progress
  - All foreign transcripts must be translated to English through a certified Credential Evaluation Service
  - Official transcripts and statements of degree will be required if you are recommended for admission
- 3 Recommendations from people who know your academic record and potential for graduate study
  - All recommendation letters are submitted online through a link that will be sent to each recommender's email once their information is listed on the recommendation list
- Standardized Test Scores
  - English Proficiency Scores (IELTS/TOEFL) are mandatory for International Students (please see the Graduate Handbook (p. 930) for more information.)
  - Depending on the prospective program's admission requirements, this may include: GRE, GMAT, and/or MAT scores
- Statement of Purpose & CV/Resume
- Supplemental Documentation
  - Depending on the prospective program's admission requirements, this may include: research papers, additional essay questions, or writing/media samples
- Application Fee
  - International Application: $85.00
  - Graduate Certificate Application: $25.00
  - Payments are made online as the last step of the Admissions application through any major credit card issuer
  - **All application fee submissions are totally non-refundable**

Non-Degree Studies

NC State's **Non-Degree Studies (NDS)** program provides opportunities for students who are not full-time degree-seeking students to enroll at NC State for a variety of reasons.

NDS students are able to enroll in courses in a breadth of disciplines, for a myriad of reasons. From professionals looking to develop and advance further in their careers, to high school students seeking college credit, NDS offers tangible benefits for students at any stage in your academic career.

Eligibility

Students that were previously admitted to and enrolled in a degree-seeking program at NC State and wish to readmit into that program are not eligible for NDS. Please visit the Readmission (https://go.ncsu.edu/readmission/) into degree-seeking programs website for more information.

More details about NDS eligibility is available on the NDS website (https://nds.registrar.ncsu.edu/apply/eligibility/).

NDS Classifications

Undergraduate Studies

- Students who have not yet obtained a baccalaureate degree
- Students enrolled in an undergraduate certificate program

Post-Baccalaureate Studies

- Students who have obtained a baccalaureate degree

Academic Enrichment Opportunities

- Rising high school juniors and seniors with a cumulative weighted GPA of 3.5 or higher

North Carolina Senior Auditors ("65+")

- North Carolina residents aged 65-years and older

How to Apply to the NDS Program

Students interested in the NDS program will apply online through our ApplyNDS portal. Depending on what type of student you are, whether you have previously been a student at NC State, and your residency (in-state, out-of-state, or international), there may be different components to the application. Details are available on the NDS website (https://nds.registrar.ncsu.edu/). It is important that applicants follow each step of the application carefully, as your application may not be considered if we are missing any important information or documentation.

Application Dates and Deadlines

NDS application deadlines are available on the NDS website (https://nds.registrar.ncsu.edu/apply/dates-and-deadlines-2/). Applicants are notified of their decision on a rolling basis.

Contact Us

Non-Degree Studies
Department of Registration and Records
1000 Harris Hall
Phone: 919-515-2572
Email: nondegreestudies@ncsu.edu
Website: go.ncsu.edu/nds (https://go.ncsu.edu/nds/)

Readmission

Sometimes students may take some time away from NC State, and that's okay. Any Undergraduate or Agricultural Institute student who has not enrolled in a Fall or Spring semester may apply for **readmission** to continue their degree program if they wish to continue.

Eligibility

Students are eligible to apply for readmission if you fall into one of the following categories:

- Former Undergraduate and Agricultural Institute students eligible to return to NC State University
- Suspended Undergraduate Students (additional action required)
- Former Undergraduates who obtained a degree and wishes to seek an additional undergraduate degree

Students who desire a **change of curriculum** can apply through the Change of Degree Application (CODA) (https://studentservices.ncsu.edu/your-degree/coda/) upon readmission, except for Leadership in the Public Sector. The Leadership in the Public Sector (LPS) major, housed within the College of Humanities and Social Sciences, is an online degree completion program for students who have been away from NC State University for more than three years. It is not available for transfer via CODA. If you are interested in this program, please review the LPS Program website (https://spia.ncsu.edu/lps/) and contact the program advisor or director before readmitting into your previous major.

Students who have completed their undergraduate degrees and wish to return to pursue an additional degree must complete the application for readmission and complete the Readmission to Additional Degree form (http://studentservices.ncsu.edu/wp-content/uploads/2018/12/Readmit-Second-Degree-072617-2-1.pdf).

Suspended Students

Students on Academic Suspension may appeal to the Admissions Committee for readmission. Students will be directed to the appeal upon completing the readmission application above. Appeals will not be reviewed unless all documents are included.

Academically Suspended students who have had a break in enrollment for at least 3 years may appeal for Contractual Readmission. Students who are contractually readmitted will be placed on Academic Warning and must maintain a 2.0 GPA on all coursework attempted after readmission. Failure to do so will result in permanent dismissal from the university.

Students are encouraged to begin the Contractual Readmission process early. Colleges may have additional requirements or deadlines; students should consult with their college and/or academic advisor before starting the contractual readmission application. Visit our website (https://studentservices.ncsu.edu/your-degree/readmission/) for more information and to download the Contractual Readmission Application Form.

How to Apply

Application dates and deadlines are updated on our website throughout the year.

All students applying for readmission to NC State must pay a non-refundable, $60 Readmission Application Fee.

The Readmission application is available online at our ApplyReadmit portal (https://go.ncsu.edu/apply_readmission/). Decisions are released on a rolling basis.

Residency Determination

All students applying for undergraduate readmission and requesting in-state tuition are required to complete the North Carolina Residency Determination Service (RDS) (https://ncresidency.cfnc.org/residencyInfo/) prior to completing the Readmission application. You will need your Residency Certification Number (RCN) in order to complete your Readmission application.

Contact Us

Readmission
Department of Registration and Records
919.515.2572
readmission@ncsu.edu

Enrollment (Registration)

Enrollment Process

Enrollment is conducted using MyPack Portal, NC State's online student services application. The Student Services Center website (https://studentservices.ncsu.edu/) houses tutorials and guides for completing enrollment as easily and efficiently as possible. A schedule of courses for each semester is also available online prior to the beginning of the enrollment period.

Enrollment consists of three steps:

1. Students meet with advisors to determine course requirements and to have their Advising Hold released;
2. Students enroll in courses in MyPack Portal; and
3. Students pay tuition, fees, and all other debts to the university by the established deadlines.

Students can find more information about how to search for classes, how to enroll, how to drop and edit their class schedules, and how to utilize degree planning tools on the Student Services Center website (https://studentservices.ncsu.edu/your-classes/).

Enrollment Calendar and Timeline

Students are assigned a date and time during which they can begin enrolling for the upcoming term. These assignments are determined by a number of factors, including the student's academic career (i.e. undergraduate, graduate, etc.), classification by credit hours (i.e. junior, senior), and any university groups the student may be a part of.

Enrollment typically begins in October for Spring and Summer semesters, and in March for Fall semesters. The enrollment calendars are published shortly before then.

New freshmen entering in the Fall enroll during summer orientation after meeting with advisors and becoming acquainted with the MyPack Portal.

The enrollment calendar is available online on the Student Services Center website (https://studentservices.ncsu.edu/calendars/enrollment/).

Schedule Revision (drops and adds)

Note: NC State University policies, rules and regulations are updated and reviewed as the need arises. For the most current information regarding this section, please visit the Policies,

Rules, and Regulations website (http://policies.ncsu.edu/regulation/reg-02-20-02/).

Courses may be added during the first week of a regular semester without permission of the instructor and during the second week with the permission of the instructor.

Courses may be dropped without regard to course load prior to the Census Date of a regular semester. After the Census Date and prior to the Drop/Revision deadline, full-time undergraduate students who wish to drop courses at any level and whose academic load would thereby fall below the twelve hour minimum course load may do so only for documented medical reasons or other verified, unforeseen grounds of personal or family hardship.

Exceptions to the drop policies require the recommendation of a student's advisor, the departmental coordinator of advising or the departmental head, and approval by the student's dean.

The full academic calendar is available on the Student Services Center website (https://go.ncsu.edu/academiccalendar/).

Students who wish to drop all courses must withdraw from the university for the remainder of the semester or summer session in which they are enrolled. All withdrawals for a current or upcoming term are initiated through the self-service Term Withdrawal page in the MyPack Portal. Withdrawals after the drop/revision deadline are approved by the university only under extenuating circumstances. Documentation is required to support these requests. More information about how to initiate a Term Withdrawal is available online (https://studentservices.ncsu.edu/your-classes/withdrawal/).

Veterans Education Benefits

NC State University is approved to administer veterans benefits to eligible students. The Veterans Education Benefits office is located in Witherspoon Student Center, suite 100. Students who are eligible to receive veterans benefits should contact the NC State Certifying Official at veterans-ed@ncsu.edu. For more information see the NC State Veterans Education website (https://veterans.ncsu.edu/benefits/).

Military Priority Registration

NC State strives to ensure the academic success of our military-affiliated students by offering priority registration to student service members, veterans and those using GI Bill® benefits. For more information regarding priority registration for military-affiliated students, please contact the university's Veterans Education Benefits office at veterans-ed@ncsu.edu.

Exchange Programs

Several enrollment programs exist for the purpose of fostering cooperative educational activities. Under these programs students have the opportunity to register for courses at other institutions and to participate in cooperative library arrangements and joint student activities.

Inter-Institutional Program

The Inter-Institutional Registration Program is a voluntary organization comprised of NC State, Duke, North Carolina Central University, University of North Carolina at Chapel Hill, University of North Carolina at Charlotte, and University of North Carolina at Greensboro for the purpose of developing and conducting cooperative educational activities. The program provides the opportunity for students to enroll at another institution for a course accepted for their program of study and not offered on their home campus. Distance education courses are not eligible to be used for Inter-Institutional registration. Other activities include a cooperative library arrangement, joint student activities, and faculty cooperation and interchange. Interested students should contact the Inter-Institutional Coordinator at (919) 515-1427 or visit the Inter-Institutional website (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

Cooperating Raleigh Colleges

The Cooperating Raleigh Colleges Program (CRC) is a voluntary organization comprised of NC State, Meredith College, St. Augustine's College, Shaw University, Wake Technical Community College, and William Peace University for the purpose of developing and conducting cooperative educational activities within the Raleigh area. The course taken at the visited school must be a course that is accepted for their program of study and not offered through NC State. Interested students should contact the Inter-Institutional Coordinator at (919) 515-1427 or visit the Cooperating Raleigh Colleges website (https://studentservices.ncsu.edu/your-classes/exchange-programs/cooperating-raleigh-colleges/).

Contact Us

For more information, contact:

Student Services Center
2000 Harris Hall
2831 Thurman Dr
Phone: 919-515-6278
Email: studentservices@ncsu.edu
Website: studentservices.ncsu.edu (https://studentservices.ncsu.edu)

GI Bill® is a registered trademark of the U.S. Department of Veterans Affairs (VA). More information about education benefits offered by VA is available at the official U.S. government website at http://www.benefits.va.gov/gibill *(*http://www.benefits.va.gov/gibill/*).*

Financial Aid

Website: studentservices.ncsu.edu (https://studentservices.ncsu.edu)

Our mission is to make an NC State education affordable and accessible. We provide scholarships, grants, loans, and work funding to support students and their families. Our staff is here to help as you navigate the process of applying for financial aid.

To be considered for financial assistance, a student must complete the Free Application for Federal Student Aid (FAFSA). This form, submitted online at www.studentaid.gov (http://www.fafsa.gov), evaluates the family's ability to pay for educational expenses. Students who submit a FAFSA to the federal processor by March 1 are given first priority for need-based scholarship and grant consideration.

By completing the FAFSA, students are considered for all forms of federal financial aid, as well as most types of state and institutional aid. Some academic scholarships may require separate applications. Determination of the applicant's need is based on estimated educational costs as established by the Office of Scholarships and Financial Aid and a consideration of the family's financial strength, as determined by the analysis of the FAFSA.

Aid is available on a non-discriminatory basis to all qualifying students based on the applicant's financial need. Financial aid offers combine aid from all sources including the federal, state and institutional funds, and private entities. Financial aid offers can include gift aid (scholarships and grants), student loans, and/or employment through the Federal Work-Study program.

Students must reapply for aid each year. Renewal is based on continued financial need as well as satisfactory academic progress as defined by the Policy (https://studentservices.ncsu.edu/your-degree/academic-progress/) on Satisfactory Academic Progress for Financial Aid Eligibility.

Please visit the Student Services Center website (http://studentservices.ncsu.edu/your-money/) for more detailed information regarding types of aid and how to apply.

Scholarships

NC State offers a variety of scholarships (https://studentservices.ncsu.edu/your-money/financial-aid/types/scholarships/) for both incoming first-year students and those who are continuing at NC State. Most scholarships require academic competitiveness or the demonstration of a specific talent or characteristic. Some scholarships require that students also demonstrate financial need. Once admitted to NC State, students can apply for scholarship consideration by using PACK ASSIST (https://ncsu.academicworks.com/), NC State University's scholarship application portal. To maximize scholarship consideration, students should apply for admission by the Early Action deadline and complete the FAFSA by March 1.

In addition to these university-wide scholarships, many colleges and departments offer scholarships to students enrolled in their academic programs. These scholarships, funded by alumni, friends of the university, foundations, and industry, are available to both incoming freshmen and continuing students. Consult the college or department websites for important deadlines and apply online with PACK ASSIST (https://ncsu.academicworks.com/). (https://go.ncsu.edu/packassist/)

NC State encourages students to search for private scholarships. Many organizations offer scholarships based on place of residence, background, professional affiliations and/or field of study. Students should use the many free online scholarship search websites to search and apply for outside scholarships.

University Academic Scholarships

Park Scholarships

The Park Scholarships program, established in 1996, brings exceptional students to NC State University based on outstanding accomplishments and potential in scholarship, leadership, service, and character. The program develops and supports Park Scholars in these areas, preparing them for lifelong contributions to the university, state, nation, and world.

Approximately 40 scholarships will be awarded this year to outstanding entering freshmen for undergraduate study in any discipline at NC State. As one of the most prestigious and comprehensive undergraduate scholarships in the nation, the Park Scholarship covers the cost of attendance for four years and includes educational trips, retreats, and seminars; enrichment grants to fund study abroad, research projects, service activities, and conferences; individualized faculty mentoring; and more.

The Park Scholarships are named for the late Roy H. Park '31, an NC State alumnus who created the charitable Park Foundation, dedicated to education, media, and the environment. The Park Foundation initially funded the Park Scholars through annual grants; then, in September 2013, the Park Foundation committed $50 million to begin an endowment for Park Scholarships. With others' support, this endowment will sustain the Park Scholarships program in perpetuity.

To date, 20 classes of Park Scholars have graduated and built a vibrant alumni network. For more information, visit the Park Scholarships website (http://park.ncsu.edu/).

Goodnight Scholars Program

The Goodnight Scholars Program, funded by a gift from Dr. Jim and Ann Goodnight, began in 2008 with 25 scholars. Since that time, it has grown into a comprehensive student development program designed to develop scholars into leaders within the STEM and/or education fields. The Program celebrated its tenth graduating class in May 2021, adding to its network of alumni stretching from coast to coast in the United States and throughout the world: all of whom are using their STEM talent to address critical societal, economical, and educational issues. Currently, the Program has more than 200 active students, and expanded to include transfer students beginning in Fall 2017.

The scholarship is targeted at low and middle-income families from North Carolina and is limited to students studying in the STEM disciplines or affiliated education majors. The current annual value of the scholarship is $20,500 and is renewable for up to four years for first-year students, and two years for transfer students. In addition to the scholarship, Goodnight Scholars have access to an assortment of developmental programming focused on their professional and personal growth, as well as enrichment grant funding to support their unique endeavors.

Dr. Jim Goodnight is founder and CEO of the SAS Institute, the world's leading business intelligence software vendor. Ann Goodnight, director of community relations at SAS, serves on the University of North Carolina Board of Governors and is a former member of the NC State Board of Trustees. Both are NC State graduates. Their frequent interactions with Goodnight Scholars provide unique and invaluable exposure to visionary leaders. Please visit the Goodnight Scholars website (https://goodnight.ncsu.edu/) for more information about the program and its exceptional scholars.

The Caldwell Fellows

The Caldwell Fellows is an intensive and comprehensive leadership development program that over 50 years at NC State has produced 1300+ outstanding alumni shaped by the Robert Greenleaf model of Servant Leadership. Supported through endowments held by the NC State Alumni Association, over 100 alumni 'invest' in individual Fellows, providing funds for their development through experiential learning. Students selected as Fellows are expected to engage deeply in the program's rich offerings, which include community based service-learning, wilderness adventure, international engagement, and capstone training at the Center for Creative Leadership. Students receive three years of stipend (divided 70-30 between tuition and funds available for experiential learning), all contingent upon a students' maintenance of the program ideals and a 3.25 cumulative GPA.

The application period for selection begins in January of each year, after a student's initial semester(s) at NC State is complete. The program actively seeks applicants from all colleges at NC State. The rigorous selection process is based on an application portfolio which includes

essays, a short video, letters of recommendation, and the first semester transcript at NC State (minimum 3.25 GPA); high school transcripts and standardized test scores are not reviewed. The application is available on the Caldwell Fellows website (http://ncsu.edu/caldwellfellows/). Application reviews by campus faculty and program alumni determine the finalists who are invited to interviews in February. Only first year students are eligible to apply.

The Caldwell Fellows program was created to honor the legacy of John T. Caldwell and to carry out his spirit and ideals. As Chancellor of NC State for 16 years, he presided over the university as a servant leader: inspiring excellence, modeling moral behavior and marshaling the strengths of the entire campus to further the common good. Guided by a deep respect for the potential inside every individual, he held a vision of NC State as a place where young people could find and refine their unique capabilities and potential. The Caldwell endowment is the only university-wide merit-based scholarship funded by alumni and supporters of NC State.

The program also derives from the NC Fellows program, originally known as the Richardson Fellows program, established in 1968 by Smith Richardson of the Richardson Vicks Corporation. Concerned for the state's future leadership, Mr. Richardson established Fellows Programs on North Carolina campuses and charged them with developing leadership in their promising students. Caldwell Fellows maintain close ties with the internationally acclaimed Center for Creative Leadership, also created by the Smith Richardson Foundation.

Open minds and open hearts are core to the Caldwell Fellows community. Curiosity, creativity, respect for diversity, and commitment to service to the greater good are common qualities which are sought and developed in all Fellows.

International Programs and Activities

Study Abroad

Study abroad allows students to develop skills required to face the grand challenges of society - deepen intercultural sensitivity, think more critically and creatively, and broaden both personal and academic perspectives. Distinguish yourself from your peers by developing skills in independence, flexibility, and the ability to deal with ambiguity. Make the world your classroom at NC State.

Study Abroad Programs

NC State offers programs worldwide that meet academic, career, and personal interests. Study Abroad is for every major: fulfill major, minor, or general education program courses abroad. Plus, participation in NC State study abroad programs fulfill the Global Knowledge co-requisite degree requirement for NC State students. Students should work with their academic advisor to identify a time frame and outline a course plan for study abroad. For all majors, with academic planning, study abroad does not delay graduation at NC State. View program options by major. (http://go.ncsu.edu/studyabroadbymajor/)

Funding Study Abroad

Study Abroad is affordable at NC State. Semester exchange programs provide the most economical option for most students since standard tuition and fees keep the cost of a semester abroad comparable to a semester on campus at NC State. Students are eligible to receive financial aid (including loans, grants, and scholarships) for the cost of *any* study abroad program. Study abroad scholarships provide additional funding to about 1/3 of applicants receiving an award, plus many other financial resources are available in support of study abroad. View information about NC State Study Abroad Scholarships (https://studyabroad.ncsu.edu/funding/nc-state-scholarships/).

Applying for Study Abroad

With hundreds of opportunities to choose from—each differing in courses, duration, language, cost, location—early planning is key to a successful study abroad experience.
Well prepared students typically start planning a year in advance.

Learn more on our website (http://studyabroad.ncsu.edu).

Study Abroad
315 Holmes Hall
Campus Box 7344
Raleigh, NC 27695
919.515.2087
study_abroad@ncsu.edu

Kim Priebe, Director

Global Perspectives Certificate

The goal of the Global Perspectives Certificate is to:

- recognize students for their international studies and activities and
- encourage students to continue their global interests both overseas and within the United States.

All undergraduate degree-seeking students and all majors are welcome, including undergraduate international students. Upon completion, students will receive an official certificate and a notation on their transcript documenting their global experiences during their studies. Learn more about the GPC and get started today at gpc.dasa.ncsu.edu (http://gpc.dasa.ncsu.edu/).

North Carolina Japan Center

Jonathan Brewster, Director

The NC Japan Center was established in July 1980 to strengthen the state's academic, economic, scientific, and cultural ties with Japan. In its many aspects, the Center serves as a focal point for interaction between Japanese and North Carolinians. It is a statewide resource intended to assist all citizens, universities, companies, and public and private institutions in relations with the Japanese. The NC Japan Center works to inform people of the state about modern Japan and its people. It also provides information and resources for Japanese citizens living in North Carolina.

Consistent with NC State's "Think and Do" land-grant mission, the NC Japan Center works in partnership with the Economic Development Partnership of North Carolina to attract Japanese businesses to the state, as well as strengthens relationships between NC State and academic partners in Japan. An external Board of Advisors includes prominent citizens of North Carolina who have a strong interest in Japan and US-Japan relations. Its Academic Advisory Committee consists of faculty from colleges across the university who provide guidance and direction for academic exchange and development. The NC Japan Center cooperates closely with the NC State Japanese language program and

provides a full range of non-credit Japanese language courses to the public.

For more information, please contact Jonathan Brewster at 919.515.3450 or visit the North Carolina Japan Center's website (http://www.ncsu.edu/japan/).

International Students

The Office of International Services (OIS) is charged with meeting the immigration advising and cross-cultural programming needs for the university's more than 4000 international students and 700 J-1 Exchange Visitor scholars who come from more than 120 different countries. Services provided by OIS include advising students and scholars on immigration regulations and university policies; authorizing certain types of on or off-campus employment authorization for F-1 and J-1 visa holders; and providing cultural programs designed to enrich the cultural and academic experience of the campus community. OIS programs include: New International Student Orientation, Culture Corps, ISSERV service learning program, English Conversation Club, and many others. New international students are required to participate in New International Student Orientation. OIS also provides opportunities for U.S. students to get involved in the international community at NC State by inviting participation in various cross-cultural programs such as volunteering at the International Student Orientation and English Conversation Club.

International applicants must apply to the Admissions Office by the stated deadlines and must meet all the necessary requirements for admission. In addition, international applicants must meet certain language and financial criteria (see the TOEFL and Financial Information sections under Freshman Admission).

The North Carolina Global Training Initiative (GTI) sponsors several short-term certificate, internship, and research programs that international students may be interested in. These full-time non-degree study programs allow international students to study at NC State for one semester in order to learn about U.S. culture and education, improve their conversational English, take undergraduate courses in their field of study back home or in preparation for admission to a degree program here in the U.S., and experience life in the U.S. These programs have a later application deadline and are great for students to take before enrolling in an undergraduate or graduate degree program in the US or for siblings and friends of current degree-seeking students who want to study in the US together.

International students may be interested in joining the GTI's Cultural Exchange Network (CENet). CENet connects NC State's domestic and international students through joint participation in social, academic, and service learning events and workshops. Visit the CENet website (https://getinvolved.ncsu.edu/organization/cenet/) for more details about the program and how you can apply.

Anyone interested in the GTI's programs can visit us on our website (https://gti.ncsu.edu/) for more information.

Outline of minimum immigration requirements for F-1 and J-1 students:

- Keep passport and I-20 or DS-2019 current
- Maintain full-time enrollment every semester (12 hours/semester for undergraduates)
- Make good academic progress toward your degree
- Do not work or intern off campus without prior written approval from OIS
- Do not work on campus more than 20 hours in any one week during the semester
- Update any address change in MyPack Portal within ten days of moving
- Update OIS immediately of any changes in name, funding, or visa status
- Consult with an OIS advisor **before** changing curriculum/majors, withdrawing, dropping below full-time, transferring to another school/program, etc.
- Purchase and maintain the NC State University approved Health and Accident Insurance or other insurance plan that meets the published minimum coverage requirements.
- Keep your valid passport and recently signed visa certificate (I-20 or DS-2019) with you when you travel abroad. Consult with an OIS advisor about visa and travel questions

Further information about immigration requirements, employment and travel questions, cultural opportunities, and other critical information designed to assist international students are detailed on the OIS website. For individual advising, please call (919) 515-2961 to make an appointment with an advisor or stop by during our walk-in hours of 10:00am-11:45am and 1:00pm-2:45pm on Monday, Tuesday, Thursday and Friday (no walk-ins on Wednesdays).

Office of International Services (OIS)
111 Lampe Drive
Campus Box 7222
NC State University
Raleigh, NC 27695-7222

919.515.2961
ois@ncsu.edu
Website (http://internationalservices.ncsu.edu/)

The Intensive English Program (Conditional Admission and IEP-only)

The Intensive English Program (IEP) at North Carolina State University is a full-time, non-credit academic program offered to international, non-native English speakers. Its mission is to provide high-quality language instruction to those seeking academic preparation, professional development and/or personal enrichment. Programs of study are offered in the fall, spring, and summer semesters.

In the IEP, students take up to 25 hours per week of intensive language study in all core language skills. Students who enroll in the IEP will be tested for the appropriate level of English instruction when they arrive on campus.

Classes are located on NC State's main campus and nearby on Hillsborough Street. IEP students are also offered the opportunity to participate in numerous cultural enrichment activities designed to help them get to know the surrounding area and interact with other students. Academic coaching (tutoring) is offered to students free of charge.

Students join the IEP as conditionally admitted students or IEP-only students. While the course of instruction is identical for both, IEP-only students are not guaranteed admission to degree programs, but may apply directly to such programs while enrolled in the IEP.

Conditional Admission

For undergraduate applicants who meet the competitive academic requirements for admission, but who do not yet possess the minimum English proficiency requirements for full, direct admission, NC State offers conditional admission. For NC State conditionally admitted students, the IEP provides the opportunity to improve one's English language skills before moving into a degree program.

Successful completion of the IEP requires achieving at least a B or higher in each course, meeting strict attendance obligations, and passing all exit requirements.

Intensive English Program
North Carolina State University
2526 Hillsborough Street, Suite 200
Raleigh, North Carolina USA 27607
Office hours: 8am-5pm, Monday-Friday

Phone: 919.515.4002
Email: iep@ncsu.edu
Website (https://intensive-english.ncsu.edu/)

Incoming Exchange Students

NC State has a growing number of international exchange partners from around the world. **The Study Abroad Office** warmly welcomes incoming exchange students to NC State's internationally renowned programs for a semester or for the full academic year.

Visit the NC State Study Abroad website (https://studyabroad.ncsu.edu/subpage-example/incoming-student/) for information about exchange programs at NC State, the application process, English proficiency requirements, preparation and arrival, and what you can expect during your time in Raleigh!

Study Abroad Office
Phone: +1 919-515-2087
Email: study_abroad@ncsu.edu
Website: https://studyabroad.ncsu.edu/

Cultural Exchange Network (CENet)

The Cultural Exchange Network (CENet) at NC State is a student organization comprised of undergraduate and graduate students from all fields of study and from around the world. CENet fosters global learning and international friendship through social, academic and service activities.

CENet is facilitated by the Global Training Initiative (GTI) and details can be found on the website (go.ncsu.edu/CENet (http://go.ncsu.edu/CENet/)).

Supplemental Academic Programs

Cooperative Education Program

The Cooperative Education Program (co-op) is an opportunity for students to gain hands-on work experience while pursuing a degree. Through alternate semesters of full-time study and full-time work experience, students can:

- Strengthen their job prospects after graduation; companies usually prefer hiring students who have related work experience, especially within their organization
- Be well-paid
- Explore career fields and confirm their choice of major
- Work with state-of-the-art equipment in the industry
- Experience "corporate culture" by working with professionals and observing how they handle job situations in the given field

The co-op plan can be completed in five years, during which time the student receives 12 to 18 months of industrial experience.

To be eligible for a co-op, students must:

- Be full-time students (in any degree program)
- Have completed a minimum of 30 credit hours (or one semester for transfer students)
- Have been admitted into a degree program prior to reporting for a co-op job
- Have a cumulative GPA of at least 2.50 (3.00 for graduate students)

For more information, visit our website (https://careers.dasa.ncsu.edu/overview/).

The Peer Mentor Program

The Peer Mentor Program (PMP), offered through the Department of Multicultural Student Affairs, is a student advisory program aims to foster a network of support for culturally diverse first-year students ("mentees"). The peer mentoring relationship is designed to aid in the academic, emotional, and socio-cultural adjustment to college life of mentees. Peer Mentors serve as peer support personnel for mentees and share program goals and responsibilities aimed at ensuring the retention of student participants.

For more information, visit our website (https://oied.ncsu.edu/divweb/msa/peer-mentor-program/).

Supplemental Instruction

Supplemental Instruction (SI) is a voluntary academic support opportunity for students in selected sections of historically difficult, large lecture courses. SI supports students who want to improve their understanding of course material in a small group setting. Students are actively engaged with small group activities facilitated by the SI leader, a trained peer tutor. Several sessions are offered at various times each week. A schedule of current SI sessions can be found on the SI website (https://tutorial.dasa.ncsu.edu/si/si-schedule/).

Tuition and Fees (Undergraduate)

The University Cashier's Office (https://treasurer.ofb.ncsu.edu/cashier/) provides billing, financial aid disbursement and account management services to all students. All students paying tuition and fees are entitled to University services, facilities and programs, including the services, facilities, and programs offered by the Student Center, Health Services, Physical Education Department, and Athletics Department.

Visit the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/) for the most up-to-date information on campus finances and student tuition and fees.

A statement of tuition and fees is posted on each student's account that registered during a normal registration period. Students (and authorized parents) are notified via e-mail (eBILL) when a new statement has posted. Payment in full, an authorized payment plan, or approved financial aid information must be received by the due date appearing on the statement. The due date is approximately two weeks before classes begin. Students registering during a late registration period will be required to pay their tuition and fees at the time of registration and may be subject to a late registration fee. Fees are the same for both residents and nonresidents and are required of all students. Schedules may be canceled for failure to cover all charges by the due date.

Estimated Annual Undergraduate Expenses

Visit https://studentservices.ncsu.edu/your-money/financial-aid/estimated-cost-of-attendance/undergraduate-student/

1. **Note: Tuition and fees are fixed items of cost. The rates listed are for Undergraduate students in a degree program. Tuition and fee rates for Distance Education courses are billed based on the student's affiliation, see the** Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/distance-education/) **for full details.**
2. **Health Insurance is billed unless you waive out of the program each semester. For more information, visit the** Student Health website (https://healthypack.dasa.ncsu.edu/insurance-and-billing/ship/).
3. **Room rent is shown as an estimate of students living on or off campus.**
4. **Meals, books and supplies, other personal expense, and transportation are shown as estimates.**
5. **For estimated costs of other student classifications please go to the** Student Services Center website (https://studentservices.ncsu.edu/your-money/financial-aid/estimated-cost-of-attendance/).

Expenses Other than Tuition and General Fees

Application Fee: A nonrefundable fee $85 U.S. must accompany each application for admission ($100 for international students). Applicants may pay the fee online using their WolfPAW account.

Room Rent: New incoming students receive instructions on how to apply for housing with the letter of acceptance. Continuing students receive room reservation information each January at their residence hall rooms. The 2022-2023 residence hall room rent typically range from $3,400 to $3,800 per semester plus mandatory charges for ResNet ($140) and streaming/cable ($46). The Wolf Village and Wolf Ridge Apartments typically range from $4,000 to $4,500 per semester plus mandatory charges for ResNet ($140) and streaming/cable ($46) per person per semester.

Meals: During their first academic year, new freshmen living on campus are required to participate in one of the university's available meal plans. Meal plans are available to all registered students and costs for 2022-2023 range from $1,410 to $2,625 plus tax. Students may also pay for meals individually at the various dining facilities available both on and near campus.

Books and Supplies: Books and supplies are usually purchased during the first week of classes directly from the NCSU Bookstores. Costs can vary,

Personal Expenses: Personal expenses vary widely among students but the estimate of $814 is based on what students report that they spend on these items.

Cooperative Education Program Fee: Required of all participating co-op students for each semester in which they are enrolled in an off campus work assignment. This fee, set at $490 for the 2022 Fall Semester, the 2023 Spring Semester, or the combined 2023 Summer Sessions, is used for partial support of the Cooperative Education Program staff in job development and placement activities. Students paying this fee are entitled to all university services, facilities, and programs during the semester or combined summer sessions for which they are enrolled.

COE Program Enhancement Fee - Students enrolled in the College of Engineering will be charged a COE Program Enhancement Fee. This fee is used for program and infrastructure improvements in the College of Engineering to ensure our engineering students are provided career-ready skills that continue to advantage them in the marketplace. Each semester, undergraduates will be charged $62.50 per credit hour. Each semester graduate students will be charged $83.33 per credit hour. Engineering students who enroll in a co-op work session will not be billed for the computing fee unless they also enroll in an NC State course.

Professional Golf Management Fee: Students enrolled in the Professional Golf Management program (PGM) will be charged $350/semester. The fee pays for golf play and practice privileges at several area golf courses.

Required Fees

Required fees are levied for services, facilities, and programs available to all students whether or not the student takes advantage of them. Students are assessed fees based on the course load they are taking. An itemization of required fees and other detailed information concerning expenses or related data can be obtained on the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/fees-explanation/).

Refund Policy

Reduction in Hours: The last day to reduce hours and receive a refund or reduction in rates is the same as the last day to register or add hours, typically the 10th day of a fall or spring term and the 4th day of a summer session. Tuition and Fees are not prorated after this date for reduced course loads. Specific dates are posted on the Student Services Center website (https://studentservices.ncsu.edu/your-money/bill/refunds-and-reimbursements/refunds-for-reduction-in-hours/) and in MyPACK Portal.

Withdrawal: Dropping all courses for which you are registered constitutes a Withdrawal from the University. Refunds for official withdrawals from NC State University are prorated based upon the percentage of the enrollment period attended. No refunds are made for official withdrawals after 50 percent of the enrollment period has passed. The prorated withdrawal schedule for each semester is publicized on the Student Services Center website (https://studentservices.ncsu.edu/your-money/bill/refunds-and-reimbursements/refunds-for-withdrawal/). In some instances circumstances such as severe medical issues can justify an appeal of your refund percentage. You may submit an appeal to the Fee Appeals Committee when you believe special consideration is

merited. Applications for such appeals may be obtained from the Student Services Center website (https://studentservices.ncsu.edu/forms/cashier/refundapp.pdf).

Residency Determination Service (RDS)

The Residency Determination Service (RDS) was established in coordination with the University of North Carolina (UNC), the North Carolina Community College System (NCCCS), the North Carolina State Education Assistance Authority (NCSEAA), and the North Carolina Independent Colleges and Universities (NCICU) as the centralized service for determining residency for students. This service enables a student to use one residency determination for admissions applications to multiple North Carolina public colleges and universities and to demonstrate residency for state aid programs consideration at all (public and private) North Carolina colleges and universities. In compliance with state law, the UNC system requires Undergraduate, Agricultural Institute, and Non-Degree Studies students to request a residency classification through the RDS.

Learn more online (https://ncresidency.cfnc.org).

Residence Status for Tuition Purposes

According to the North Carolina General Assembly (North Carolina General Statutes Section (G.S.) 116-143.1(b) (http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_116/GS_116-143.1.html)), a student qualifies as a resident for tuition purposes if he or she has:

- an established legal residency (domicile) in North Carolina
- maintained that legal residence for at least 12 continuous months prior to being considered for in-state residency

The North Carolina State Residence Classification Manual (http://www.northcarolina.edu/sites/default/files/documents/state_residence_classification_manual.pdf) offers complete information on residency statutes, as well as explanations as how the two qualifications above are evaluated.

Initial Classification: The student's initial residence classification occurs during the admission application process when the student is first admitted to a community college or UNC institution.

Reclassification: A student, accepted for admission, who is initially classified as a nonresident and believes he or she meets the requirements of G.S. 116-143.1, -143.3, or any other applicable laws and regulations may request a reclassification by completing the RDS process. The request for reclassification may be submitted either in direct response to the initial classification (if the student believes the initial classification is erroneous), or at a future time if the student has experienced a change in circumstances that he or she believes makes him or her eligible for in-state resident status. Students must submit requests for reclassification in accordance with approved procedures and application deadlines. The institution will not assume responsibility for initiating such an inquiry independently.

Residency Reclassification Application Deadlines. Except for deadlines set out in the General Statutes, institutions (undergraduate or graduate) may set their own deadlines so long as they are not inconsistent with the deadlines. The deadline to submit the reclassification application along with all supporting documentation cannot be later than the 10th business day of the term for which the student is seeking residency reclassification. All conditions necessary for achieving in-state status must still be satisfied prior to the beginning of the academic term for which the student is seeking reclassification. It is the student's responsibility to provide the documentation necessary to support his or her claims for in-state residency for tuition purposes by the applicable deadlines.

Residence. To qualify as a resident for tuition purposes, a person must become a legal resident and remain a legal resident for at least twelve consecutive months (365 days) immediately prior to classification. Thus, there is a distinction between legal residence and residence for tuition purposes. Furthermore, twelve months legal residence means more than simple abode in North Carolina. In particular, it means maintaining a domicile (permanent home of indefinite duration) as opposed to "maintaining a mere temporary residence or abode incident to enrollment in an institution of higher education." The burden of establishing facts which justify classification of a student as a resident entitled to in-state tuition rates is on the applicant for such classification, who must show his or her entitlement by the preponderance (the greater part) of the residentiary information.

Parents' Domicile. If an individual, irrespective of age, has living parent(s) or court appointed guardian of the person, the domicile of such parent(s) or guardian is, prima facie, the domicile of the individual; but this prima facie evidence of the individual's domicile may or may not be sustained by other information. Further, non-domiciliary status of parents is not deemed prima facie evidence of the applicant child's status if the applicant has lived (though not necessarily legally resided) in North Carolina for the five years preceding enrollment or registration.

Effect of Marriage. Marriage alone does not prevent a person from becoming or continuing to be a resident for tuition purposes, nor does marriage in any circumstance insure that a person will become or continue to be a resident for tuition purposes. Marriage and the legal residence of one's spouse are, however, relevant information in determining residentiary intent. Furthermore, if both a husband and his wife are legal residents of North Carolina and if one of them has been a legal resident longer than the other, then the longer duration may be claimed by either spouse in meeting the twelve month requirement for instate tuition status.

Military Personnel. Any active duty member of the armed services qualifying for admission to an institution of higher education but not qualifying as a resident for tuition purposes shall be charged the in-State tuition rate and applicable mandatory fees for enrollments while the member of the armed services is abiding in this State incident to active military duty in this State. In the event the active duty member of the armed services is reassigned outside of North Carolina or retires, the member shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the member is continuously enrolled in the degree or other program in which the member was enrolled at the time the member is reassigned. In the event the active duty member of the armed services receives an Honorable Discharge from military service, the member shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the member establishes residency in North Carolina within 30 days after the discharge and is continuously enrolled in the degree of other program in which the member was enrolled at the time the member is discharged.

Any dependent relative of a member of the armed services who is abiding in this State incident to active military duty, as defined by the Board of Governors of The University of North Carolina and by the State Board of Community Colleges while sharing the abode of that member shall be eligible to be charged the in-State tuition rate, if the dependent

relative qualifies for admission to an institution of higher education. The dependent relatives shall comply with the requirements of the Selective Service System, if applicable, in order to be accorded this benefit. In the event the member of the armed services is reassigned outside of North Carolina or retires, the dependent relative shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the dependent relative is continuously enrolled in the degree or other program in which the dependent relative was enrolled at the time the member is reassigned or retires. In the event the member of the armed services receives an Honorable Discharge from military service, the dependent relative shall continue to be eligible for the in-State tuition rate and applicable mandatory fees so long as the dependent relative establishes residency within North Carolina within 30 days after the discharge and is continuously enrolled in the degree or other program in which the dependent relative was enrolled at the time the member is discharged. A person charged less than out-of-state tuition rate solely by reason of this section shall not, during the period of receiving that benefit, qualify for or be the basis of conferring the benefit of G.S. 116-143.1.

Grace Period. If a person (1) has been a bona fide legal resident, (2) has consequently been classified a resident for tuition purposes, and (3) has subsequently lost North Carolina legal residence while enrolled at a public institution of higher education, that person may continue to enjoy the in-state tuition rate for a grace period of twelve months measured from the date on which North Carolina legal residence was lost. If the twelve months ends during an academic term for which the person is enrolled at a State institution of higher education, the grace period extends, in addition, to the end of that term. The fact of marriage to one who continues domicile outside North Carolina does not by itself cause loss of legal residence marking the beginning of the grace period.

Minors. Minors (persons under 18 years of age) usually have the domicile of their parents, but certain special cases are recognized by the residence classification statute in determining residence for tuition purposes.

a) If a minor's parents live apart, the minor's domicile is deemed to be North Carolina for the time period(s) that either parent, as a North Carolina legal resident, may claim and does claim the minor as a tax dependent, even if other law or judicial act assigns the minor's domicile outside North Carolina. A minor thus deemed to be a legal resident will not, upon achieving majority before enrolling at an institution of higher education, lose North Carolina legal residence if that person

1. Upon becoming an adult "acts, to the extent that the person's degree of actual emancipation permits, in a manner consistent with bona fide legal residence in North Carolina" and
2. Begins enrollment at an institution of higher education not later than the fall academic term following completion of education prerequisite to admission at such institution."

b) If a minor has lived for five or more consecutive years with relatives (other than parents) who are domiciled in North Carolina and if the relatives have functioned during this time as if they were personal guardians, the minor will be deemed a resident for tuition purposes for an enrolled term commencing immediately after at least five years in which these circumstances have existed. If under this consideration a minor is deemed to be a resident for tuition purposes immediately prior to his or her eighteenth birthday, that person on achieving majority will be deemed a legal resident of North Carolina of at least twelve months duration. This provision acts to confer in-state tuition status even in the face of other provisions of law to the contrary; however, a person deemed a resident of twelve months duration pursuant to this provision continues to be a legal resident of the State so long as he or she does not abandon North Carolina domicile.

Lost but Regained Domicile. If a student ceases enrollment at or graduates from an institution of higher education while classified as a resident for tuition purposes and then both abandons and re-acquires North Carolina domicile within a twelve month period, that person, if he or she continues to maintain the reacquired domicile into re-enrollment at an institution of higher education, may re-enroll at the instate tuition rate without having to meet the usual 12-month durational requirement. However, any one person may receive the benefit of this provision only once.

Change of Status. A student admitted to initial enrollment in an institution (or permitted to enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) must be classified by the admitting institution either as a resident or as a nonresident for tuition purposes prior to actual enrollment. A residence status classification once assigned (and finalized pursuant to any appeal properly taken) may be changed thereafter (with corresponding change in billing rates) only at intervals corresponding with the established primary divisions of the academic year.

Transfer Students. When a student transfers from one North Carolina public institution of higher education to another, he or she is treated as a new student by the institution to which he or she is transferring and must be assigned an initial residence status classification for tuition purposes.

Non-U.S. Citizens. Persons who are not U.S. citizens but who have certain visa and immigration statuses that grant them the legal ability to establish and maintain a bona fide domicile in this country are subject to the same considerations as U.S. citizens in determining residence status for tuition purposes. If it is later discovered that the person's visa or immigration status was obtained fraudulently, the institution shall have the right to seek and collect payment of full, out-of-state tuition, along with fees and costs associated with such collection. Non-U.S. citizens present in the United States under certain visa statuses such as tourists, visitors on business, and temporary foreign/international students do not have the legal capacity to establish a bona fide domicile in this country (and thus, not in North Carolina). As examples, holders of non-immigrant visa statuses such as B, C, D, F, J, M, Q, S, and TN visas (and dependent visas for spouses and children such as a TD visa) cannot establish domicile with these documents, in and of themselves, unless there is a change in their visa status. An EAD, in and of itself, does not confer any immigrant or non-immigrant status and does not give the EAD holder the legal capacity to establish residency for tuition purposes in this state.

UNC System Employees. A person who is a full-time employee, in a permanent position, of The University of North Carolina, or is the spouse or dependent child of a full-time employee, in a permanent position, of The University of North Carolina, and who is a legal resident of North Carolina, qualifies as a resident for tuition purposes without having maintained that legal residence for at least 12 months immediately prior to his or her classification as a resident for tuition purposes.

The following categories of persons are eligible for tuition waivers:

Survivors of Deceased Law Enforcement/ Emergency Workers. Tuition waivers are available to the surviving spouse and children of a law enforcement officer (including sheriffs), firefighter, volunteer firefighter or rescue squad worker who was killed as a direct result of a traumatic injury sustained in the line of duty (including both active service and training for active duty). Additional eligibility requirements must be met.

Families of Disabled Law Enforcement/Emergency Workers .Tuition waivers are available to the spouses and children of law enforcement officers (including sheriffs), firefighters, volunteer firefighters, or rescue squad workers who are permanently and totally disabled as a direct result of a traumatic injury sustained in the line of duty (including both active service and training for active service). Additional eligibility requirements must be met.

Note: Decisions on residence for tuition purposes are based on NC G.S. 116-143.1 and 116-143.3 and on the State Residence Classification Manual which was prepared by the General Administration of the University of North Carolina system.

This information is subject to change.

Tuition and Fees (Graduate)

The University Cashier's Office (https://treasurer.ofb.ncsu.edu/cashier/) provides billing, financial aid disbursement and account management services to all students. All students paying tuition and fees are entitled to University services, facilities and programs, including the services, facilities, and programs offered by the Student Center, Health Services, Physical Education Department, and Athletics Department.

Visit the Student Services Center website (https://studentservices.ncsu.edu/your-money/tuition-and-fees/) for the most up-to-date information on campus finances and student tuition and fees.

Students should view the Graduate School website for important information on Residence for Tuition Purposes (https://grad.ncsu.edu/admissions/residency/) and the North Carolina Residency Determination Service (RDS) for graduate programs.

Campus Resources

NC State's vast university offices and divisions exist to serve our students, faculty, staff, visitors and guests. The units below showcase just a sampling of the important work being done on and off campus every day to ensure that our community has the resources they need to achieve and thrive at NC State.

Digital Education and Learning Technology Applications (DELTA)

DELTA supports NC State's online and distance education program activities and services. We provide application, enrollment and services for non-degree studies' students. We provide student communications, a virtual orientation, an online FAQ, campus proctoring services and remote testing arrangements. DELTA collaborates with other NC State units to provide library resources, student registration, campus authentication, financial aid and billing services for online and distance education students. For more information, visit the Online and Distance Education website (https://online-distance.ncsu.edu/).

DELTA manages the university's learning technology infrastructure, including various learning management tools. WolfWare contains access to Moodle and other enterprise-level technology tools, such as Zoom, a tool for synchronous online teaching and learning, and Panopto lecture-capture technology. DELTA supports technology-assisted courses, whether online or on-campus.

DELTA Testing Services manages on-campus test centers and works with remotely based proctors as well.

Donna Peterbridge
Interim Vice Provost for DELTA

Tim Petty
Associate Vice Provost, Online and Distance Education

Alexis Lockett
Program Manager, Online and Distance Education

Sharon Broere
Director, DELTA Testing Services

Office of Information Technology

NC State offers you a leading-edge academic computing environment to enrich your student life and learning. Here, you'll find that many colleges and administrative and academic units are involved in providing various IT resources, services and information.

The Office of Information Technology (OIT) provides centralized campus-wide computing and information and communication technology services in support of the university's academic and administrative goals. Some of OIT's major services are:

- Campus-wide data network infrastructure, including the multi-gigabit network backbone and wireless computing infrastructure
- MyPack Portal, the gateway to university online enterprise systems and services, such as Human Resources, Financials and the Student Information System
- ResNet, high-speed wired and wireless Internet access for students living in campus housing
- Hundreds of software packages for student use from computing labs, and many also available from the NC State Virtual Computing Lab (VCL) environment
- Google Workspace, which provides the university's official email and calendaring services and numerous collaborative tools powered by Google
- University's central Web servers
- File space
- Classroom technology support
- High Performance Computing (HPC) for researchers and students in computational science
- IT security for campus computing resources, including acceptable use, rules and regulations
- NC State Help Desk, which provides support to students and other users of campus resources
- Hardware and software support for student-owned computers through the OIT Walk-in Center

Unity ID and Password

As an NC State student, you will have a Unity ID and password, which are your credentials to access campus-wide computing services and facilities.

Information about your Unity ID and password and help are provided during student orientation sessions, from the NC State Help Desk, and online on the OIT (https://oit.ncsu.edu) website.

Unity Labs

As a student, you may use the Unity computer labs that are equipped with Windows, Linux and Macintosh workstations that provide direct access to information technologies. Colleges and academic departments support additional computing facilities, and overall, there are about 100 student-computing labs on campus, with about 2,500 workstations with high-speed network connections. NC State does not require you to own a computer, although specific colleges or programs may make this requirement. Information about computer recommendations, specifications and purchasing options are published online on the OIT (https://oit.ncsu.edu) website and updated annually.

Help

For additional information, see NC State's computing resources:

- OIT (https://oit.ncsu.edu) website
- OIT Walk-in Center, West Dunn Building (corner of Dan Allen and Thurman drives)
- NC State Help Desk, 515-HELP (4357) or help.ncsu.edu (https://help.ncsu.edu)

Marc Hoit, Vice Chancellor for Information Technology and Chief Information Officer

Office for Institutional Equity and Diversity

The Office for Institutional Equity and Diversity (OIED) is committed to fostering an inclusive, accessible and diverse intellectual and cultural campus experience related to the mission of NC State University.

Inclusive Excellence and Strategic Practice

IESP champions diversity and inclusion practices across various stakeholders of the university community through education, training, the development of relationships, enhanced understanding of diversity and equity issues, the utility of assessment and evaluation, facilitation of initiatives, cooperative accountability and collaboration.

Equal Opportunity and Equity

The Equal Opportunity and Equity unit of the Office for Institutional Equity and Diversity strives to make NC State University a discrimination-free, harassment-free environment for faculty, students and staff to work, live and learn. This unit is responsible for managing and monitoring the university's equal opportunity compliance activities, overseeing the university's equal opportunity policies, responding to complaints, conducting investigations, developing and delivering training and educational outreach to campus and consulting with supervisors, managers and unit equity officers regarding equal opportunity concerns and initiatives, including affirmative action and equitable hiring practices.

Bias Impact Response Team

The Bias Impact Response Team (BIRT) at NC State supports the campus community by providing a system through which a person can report incidents of bias on and around campus. BIRT seeks to effectively engage with impacted individuals and groups to achieve awareness, support, education and restoration. See the BIRT website at bias-incident.ncsu.edu (http://bias-incident.ncsu.edu/).

Campus Community Centers

NC State's Campus Community Centers report to the Office for Institutional Equity and Diversity (OIED). Collectively, the centers foster community; celebrate identity and culture; raise awareness; and support, empower and advocate for positive change for underrepresented and marginalized students, families and communities. They assist OIED in its goal of fostering an inclusive, accessible and diverse intellectual and cultural campus experience by creating spaces and activities that improve campus climate and enhance the overall educational experience for all students.

*See **Campus Community Centers** under Student Services for information on the African American Cultural Center, GLBT Center, Multicultural Student Affairs and the Women's Center, which report to the Office for Institutional Equity and Diversity.*

231 Winslow Hall
Box 7530
NC State University
Raleigh, NC 27695-7530
Phone: 919.515.3148
Website: www.diversity.ncsu.edu (https://diversity.ncsu.edu/)

Sheri Schwab, J.D.
Vice Provost

Office of Professional Development

NC State University's **Office of Professional Development (OPD)** is a unit of the office of Continuing and Professional Education (https://mckimmoncenter.ncsu.edu/cpe/). Dedicated to the development and delivery of non-degree professional training courses, OPD provides you with a broad range of quality educational opportunities in a flexible, comfortable, and affordable learning environment.

The Office of Professional Development (OPD) develops, promotes, and coordinates noncredit seminars, certificate programs, and conferences to a broad market on a wide range of topics. Program areas include:

- test preparation;
- accounting and taxation;
- agriculture;
- communications;
- education;
- engineering;
- English as a second language;
- environmental;
- management;
- textiles;
- and general interest.

Events management services are available to help both campus and non campus groups more efficiently and productively administer educational seminars, workshops, and conferences.

Dan Gerger, Director
Website: ncsu.edu/opd (http://ncsu.edu/opd/)
Phone: (919) 515-8179
Email: ContinuingEducation@ncsu.edu

Office of Research and Innovation

Mladen A. Vouk, *Vice Chancellor for Research and Innovation*
Wade Fulghum, *Assistant Vice Chancellor, Office of Research Commercialization*
Genevieve Garland, *Assistant Vice Chancellor for Research Operations and Communications*
Jonathan Horowitz, *Associate Vice Chancellor for Research Infrastructure and Development*
Rick Liston, *Assistant Vice Chancellor for Administration*
Lorena McLaren, *Executive Director, Corporate and Foundation Relations, University Development*
Sherrie Settle, *Associate Vice Chancellor for Sponsored Programs and Regulatory Compliance*
Alyson Wilson, *Associate Vice Chancellor for National Security and Special Research Initiatives*

Office of the Vice Chancellor

Vice Chancellor

As Chief Research Officer (CRO), the Vice Chancellor oversees all research activities at NC State. Under his authority, units reporting to the Office of Research and Innovation centrally manage research administration, the university' s intellectual properties, and industry and government agency alliances on the university ' s award-winning research campus. Researchers at NC State are supported by $405++ million in sponsored programs from federal, local government, industry, and nonprofit organizations. NC State' s research portfolio exceeds 5,000 invention disclosures, 960+ US patents (OR rated #6 in patents issued), 800 active commercialization agreements, and 595+ products to market. Centennial Campus hosts more than 70 corporate, government and nonprofit partners working with the university's 75+ centers and institutes, laboratories and research departments

Research Operations

The Research Operations Unit provides strategic leadership and support to the Office of Research and Innovation. The office consists of three units: Strategic Initiatives, Education and Training, and Marketing and Outreach.

Integrated Support Services Center (ISSC)

The ISSC was created to provide streamlined, professional services to faculty and administrators, eliminating costly duplication, creating efficiency and improving timeliness.

Research Development

Research Development Office (RDO)

The RDO facilitates collaboration between faculty and interdisciplinary research experts, providing strategic and responsive support that enhances the university's most valued research initiatives. By searching a centralized, easy-to-access portal, researchers quickly find internal and external funding opportunities. Once identified, potential funding translates to successful grants with the help of Research Development's tools and training resources that support researchers as they plan, write, and submit competitive proposals.

Centers + Institutes

NC State's Centers and Institutes reflect the university's commitment to interdisciplinary scholarly pursuit, including research, instruction and public service. These cutting-edge organizations are frontrunners in their field, blazing the trails for other researchers to follow. Research and innovation on topics ranging from climate change to textiles add value to the everyday lives of our state's citizens, maintaining public trust and admiration and standing at the forefront in global excellence for research and discovery. Here, the leadership of these organizations can access the materials, procedures and policies necessary to manage their efforts responsibly, equitably and with the highest integrity.

Proposal Development Unit (PDU)

The PDU supports faculty teams in the development of large-scale, interdisciplinary research proposals. These services include team facilitation, budget development, writing and editing, and administrative assistance, thereby enabling investigators to concentrate on the research-related aspects of their proposals. PDU support is available to NC State faculty planning proposals with estimated total budgets of at least $1M.

Research Administration and Compliance

Sponsored Programs & Regulatory Compliance Services (SPARCS)

SPARCS facilitates the submission of proposals, negotiation of agreements, the administration of internally and externally funded projects, and the administration of subagreements that provide funding to NC State. This includes all aspects of externally sponsored research and scholarship, from pre-award management to non-fiscal post--award management.

Office of Research Commercialization

Office of Research Commercialization (ORC)

NC State University is a research powerhouse and a powerful economic engine for North Carolina. ORC plays a crucial role in this by protecting and promoting University research discoveries and intellectual property, working with and guiding industry partners, and promoting the acceleration of startups. ORC provides innovators with a wide range of programs and services to protect, market, and license intellectual property developed at NC State. Collaboration with NC State innovators and industry partners has led to the creation of more than 125+ startups and 575+ commercialized products that benefit society on a local, national and global scale. Among surveyed universities without medical schools, NC State consistently ranks among the top 10 for key technology transfer metrics.

University Advancement

The mission of University Advancement at NC State is to coordinate internal and external communication to enhance the image of the university, to provide meaningful programs and services to alumni and friends, to seek service-support participation and ambassadorship from constituents, to build and sustain a strong volunteer leadership network, to raise money from private sources, to manage the collection of private gifts for the university, to manage effective alumni and development databases and gift systems, and to coordinate with the General Administration in areas of government and legislative priorities in Raleigh and Washington. The office oversees University Development, the Alumni Association, University Communications and Marketing, and Advancement Services. Visit the University Advancement website (https://leadership.ncsu.edu/advancement/) for more information.

Advancement Services

Advancement Services supports the operations of Alumni Relations, University Development and University Communications. The department oversees the alumni and donor database and works to process gifts and conduct research about potential contribution opportunities. Other initiatives include management of the university's online giving website; support of the Alumni Association alumni web portal; delivery of education and training in national best practices related to fundraising activities, ethics and accountability; and management of an international listserv dedicated to the advancement services profession.

Alumni Association

The NC State Alumni Association engages alumni through programs and services that foster pride and enhance lifelong connections to NC

State. The association encourages alumni to be Red and White for Life — with connections to the university and fellow alumni no matter where they live by linking alumni to the university through membership, a growing network of alumni around the world, programming for special-interest groups and students, events and an array of communication tools, including the award-winning *NC State* magazine. The Alumni Association offers membership options and benefits for alumni who join, and supports a growing **Student Alumni Association (SAA)**, with events and programming that builds connections and enhances their student experience. The association also sustains the prestigious Caldwell Fellows scholarship program, funded by alumni endowments and contributions, and designed to foster academic excellence, leadership, personal growth and service-learning. The association upholds campus traditions such as the official class ring, Red and White Week, Ram Roast, the Tradition Keepers Medals, Wolfpack freshmen welcome events, and Founders' Day, as well as the Legacy Luncheon for incoming freshmen whose parents and/or grandparents attended NC State. In addition, the association is responsible for the Evening of Stars Gala to celebrate NC State's distinguished alumni, and the Faculty Awards to recognize the achievements of the university's outstanding undergraduate and graduate faculty. The association offers services such as the Wolf Treks alumni travel program and Career Services. Students and alumni can visit the Alumni Association in the Dorothy and Roy Park Alumni Center on Centennial Campus, or contact the Alumni Association at (919) 515-3375 or (800) 627-2586. For a complete overview of programs, services and events, visit the Alumni Association's website (http://www.alumni.ncsu.edu).

University Development

University Development works with the colleges and programs at NC State to secure private financial support for priority projects and programs. This support may come from individuals (alumni, parents, students, faculty, staff, and friends), corporations, philanthropic foundations, or other organizations. The mission of University Development is to strengthen relationships with alumni and friends and reconnect them with campus colleagues in their colleges and areas of interest; reach out to alumni and friends living outside North Carolina to carry the messages of NC State's progress, success, and vision for the future; and to serve as liaisons to universitywide programs to support their fundraising and outreach efforts.

University Development provides services to the colleges and programs in capital campaigns, gift planning, corporate and foundation relations, and annual giving. University Development also facilitates external and internal communication among fundraisers, and coordinates approaches to prospective donors.

University Communications and Marketing

University Communications and Marketing builds positive relationships between NC State and its many constituents through strategic internal and external communications that convey the university's brand identity. The division is comprised of University Communications, Marketing Communications, University Special Events, and Development Communications and Stewardship, and focuses on:

- Increasing awareness of the university's distinctive benefits.
- Ensuring consistency in universitywide messaging and visual identity by facilitating integration and coordination of public relations and communications efforts throughout the university.
- Monitoring and responding to public issues and perceptions.
- Providing marketing, communication and web strategy counsel and services to campus clients.
- Providing guidance and resource assistance for university events.

Leadership

Brian C. Sischo, **Vice Chancellor for University Advancement**

Brad Bohlander, **Associate Vice Chancellor for University Communications and Marketing and Chief Communications and Marketing Officer**
Jim Broschart, **Associate Vice Chancellor for University Development**
Derek Bryan, **Assistant Vice Chancellor of Finance and Administration**
Jeff Baynham, **Associate Vice Chancellor for Advancement Services**
Maggie Musick, **Executive Assistant to the Vice Chancellor**
Reid Ricciardi, **Executive Director of Talent Management**
Benny Suggs, **Associate Vice Chancellor for Alumni Relations and Executive Director of the Alumni Association**
Alan Taylor, **Assistant Vice Chancellor for Principal Gifts**
Christina Walker, **Chief of Staff and Executive Director of University Advancement**

NC State Policies

North Carolina State University is committed to academic integrity, and all students are required to adhere to the NC State Code of Student Conduct (https://policies.ncsu.edu/policy/pol-11-35-01/). Individual policies on conduct, including those listed below, are posted on University Policies, Regulations, and Rules (https://policies.ncsu.edu/) (PRRs).

University Patent Procedures (https://policies.ncsu.edu/policy/pol-10-00-01/)
Grievance Procedures for Graduate Students (https://policies.ncsu.edu/regulation/reg-11-40-02/)
Code of Student Conduct (https://policies.ncsu.edu/policy/pol-11-35-01/)
Academic Integrity (https://policies.ncsu.edu/policy/pol-11-35-01/)
Policy on Illegal Drugs (https://policies.ncsu.edu/policy/pol-04-20-05/)
Sexual Harassment Policy (https://policies.ncsu.edu/regulation/reg-04-25-02/)
Racial Harassment Policy (https://policies.ncsu.edu/regulation/reg-04-25-02/)
University Copyright Procedures (https://policies.ncsu.edu/regulation/reg-01-25-03/)

Equal Opportunity and Non-Discrimination

It is the policy of the State of North Carolina to provide equality of opportunity in education and employment for all students and employees. Accordingly, the university does not practice or condone unlawful discrimination in any form against students, employees or applicants on the basis of race, color, religion, creed, sex, national origin, age, disability or veteran status. Nor does the university allow discrimination on the basis of sexual orientation with respect to internal university matters that do not contravene federal or state law and that do not interfere with the University's relationships with outside organizations, including the federal government, the military, ROTC, and private employers. [NOTE: The NC State University equal opportunity and nondiscrimination policy includes transsexual individuals within the policy's prohibitions against discrimination on the basis of sex. This includes actual or perceived gender identity and gender expression. See Price Waterhouse v. Hopkins, 490 U.S. 228 (1989); Smith v. City of Salem, 378 F.3d 566 (6th Circ. 2004).] Retaliation against any person complaining of discrimination is in violation of federal and state law and North Carolina State University policy, and will not be tolerated.

Unlawful Harassment

Harassment based upon race, color, religion, creed, sex, national origin, veteran status, age, or disability is a form of discrimination in violation of federal and state law and North Carolina State University policy and will not be tolerated. It is the internal policy of North Carolina State University to prohibit harassment on the basis of sexual orientation. Retaliation against any person complaining of harassment is in violation of federal and state law and North Carolina State University policy, and will not be tolerated. North Carolina State University will respond promptly to all complaints of harassment and retaliation. Violation of this policy can result in serious disciplinary action up to and including expulsion for students or discharge for employees.

Every individual is encouraged, and should feel free, to seek assistance, information and guidance from his/her supervisor, the Office for Equal Opportunity, the Office of Student Conduct or the Employees Relations section of Human Resources. For additional information, contact: Office for Equal Opportunity, 1 Holladay Hall, Box 7530, North Carolina State University, Raleigh, NC 27695-7530, Phone: (919) 513-1234 or 515-3148.

Disability Resource Office

Individuals desiring reasonable accommodations for their documented disabilities should contact the Disability Resource Office (https://dro.dasa.ncsu.edu/) (DRO), 2751 Cates Avenue, Holmes Hall, (919) 515-7653 (Voice), (919) 515-8830 (TTY). Services and accommodations are provided based on an individual's documented needs and are determined in consultation with the individual and a DRO representative. For students, such requests should be made far in advance of registration deadlines to ensure timely services and accommodations. DRO will maintain appropriate confidentiality of records and communication regarding disability.

Associations and Accreditation

Associations

The university is a member of the Association of Public and Land-grant Universities, the American Council on Education, the Association of Governing Boards of Universities and Colleges, the Association of American Colleges and Universities, the Education Advisory Board, the Engagement Scholarship Consortium, the National Association of College and University Business Officers, the Oak Ridge Associated Universities, the Southern Association of Colleges and Schools Commission on Colleges, Campus Compact, the University Professional and Continuing Education Association, and the Cooperating Raleigh Colleges.

Accreditation

NC State is accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) to award associate, baccalaureate, masters, and doctorate degrees. Questions about the accreditation of NC State may be directed in writing to the Southern Association of Colleges and Schools Commission on Colleges at 1866 Southern Lane, Decatur, GA 3003-4097, by calling 404.679.4500 or by using information available on SACSCOC's website (https://www.sacscoc.org/).

In addition, many of the university's professional programs and departments are accredited by national professional associations, including:

Specialized Academic Program Accreditation (https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/)

College of Agriculture & Life Sciences (https://cals.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Agricultural Education (BS)[1]	Council for the Accreditation of Educator Preparation (CAEP)	2015	2022[2]

Biological Engineering (BS)[3]	Engineering Accreditation Commission of ABET	2017	2023

1 Accredited through the College of Education.

2 Review completed, awaiting results.

3 Accredited through the College of Engineering

College of Design (http://design.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Architecture (B.Arch, M.Arch)	National Architectural Accreditation Board (NAAB)	2018	2026
Graphic Design (BGD, MGD)	National Association of Schools of Art and Design (NASAD)	2012	2021[1]
Industrial Design (BID, MID)	National Association of Schools of Art and Design (NASAD)	2012	2021[1]
Landscape Architecture (MLA)	Landscape Architectural Accreditation Board (LAAB)	2016	2022[2]

1 Review completed, awaiting results.

2 Site visit completed, awaiting findings.

College of Education (https://ced.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Counselor Education (PhD, MEd) (MEd concentrations are: Clinical Mental Health Counseling, School Counseling, and College Counseling)	Council for Accreditation of Counseling and Related Educational Programs (CACREP)	2022	2024
All teacher education programs, School Counselor (MEd, MS), School Administration (MSA) and School of Social Work (MR) at initial and advanced levels.	Council for the Accreditation of Educator Preparation (CAEP)	2015	2022[1]

1 Review completed, awaiting results.

College of Engineering (http://www.engr.ncsu.edu/)

The Office of Assessment and Accreditation website (https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/) provides the accreditation dates for the following programs. Each of the following programs' next comprehensive review date is 2022-2023.

Program Name	Accrediting Body
Aerospace Engineering (BS)	Engineering Accreditation Commission of ABET
Biological Engineering (BS)	Engineering Accreditation Commission of ABET
Biomedical Engineering (BS)	Engineering Accreditation Commission of ABET
Chemical Engineering (BS)	Engineering Accreditation Commission of ABET
Civil Engineering (BS)	Engineering Accreditation Commission of ABET
Computer Engineering (BS)	Engineering Accreditation Commission of ABET
Computer Science (BS)	Computing Accreditation Commission of ABET
Construction Engineering and Management (BS)	Engineering Accreditation Commission of ABET
Electrical Engineering (BS)	Engineering Accreditation Commission of ABET
Engineering - Mechanical Engineering Systems Concentration (BS)	Engineering Accreditation Commission of ABET
Engineering - Mechatronics Concentration (BS) (Joint Program with UNC-Asheville)	Engineering Accreditation Commission of ABET
Environmental Engineering (BS)	Engineering Accreditation Commission of ABET
Industrial Engineering (BS)	Engineering Accreditation Commission of ABET
Materials Science and Engineering (BS)	Engineering Accreditation Commission of ABET
Mechanical Engineering (BS)	Engineering Accreditation Commission of ABET
Nuclear Engineering (BS)	Engineering Accreditation Commission of ABET

Paper Science and Engineering (BS)	Engineering Accreditation Commission of ABET
Textile Engineering (BS)	Engineering Accreditation Commission of ABET

College of Humanities & Social Sciences (http://www.chass.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Advanced Studies School Psychology (MS/ Certificate)	National Association of School Psychologists	2021	2027
Human Factors/ Ergonomics Psychology (PhD)	Human Factors and Ergonomics Society (HFES)	2018	2024
Public Administration (MPA)	National Association of Schools of Public Affairs and Administration (NASPAA)	2021	2028
School Psychology (PhD)	American Psychological Association	2014	2021[2]
Social Work (BSW, MSW)	Council on Social Work	2021	2029
Spanish/French Education (LAA, LTA, LTF)	Council for the Accreditation of Educator Preparation (CAEP)	2022	2029

Poole College of Management (http://www.mgt.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Accounting (BS, MAC)	Association to Advance Collegiate Schools of Business (AACSB International)	2020	2025
Business Administration (BS, MBA)	Association to Advance Collegiate Schools of Business (AACSB International)	2020	2025
Master of Global Innovation Management (MGIM)	Association to Advance Collegiate Schools of Business (AACSB International)	2020	2025

College of Natural Resources (https://cnr.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Forest Management (BS)	Society of American Foresters	2015	2026
Natural Resources (BS)	Society of American Foresters	2016	2026
Master of Forestry	Society of American Foresters	2016	2026
Paper Science & Engineering (BS)[1]	Engineering Accreditation Commission of ABET	2017	2023
Parks, Recreation & Tourism Management (BS)	Council on Accreditation of Parks, Recreation, Tourism & Related Professions	2017	2024
Professional Golf Management (BS)	Professional Golf Association of America	2015	2021[2]
Sustainable Materials & Technology (BS)	Society of Wood Science & Technology	2015	2025

[1] Accredited through the College of Engineering.

[2] This site visit has been rescheduled for a later date due to COVID-19.

College of Sciences (https://sciences.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Chemistry (BA, BS)	American Chemical Society (ACS)	2017	2023

Wilson College of Textiles (https://textiles.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Textile Engineering (BS)[1]	Engineering Accreditation Commission of ABET	2017	2023

[1] Accredited through the College of Engineering.

College of Veterinary Medicine (http://www.cvm.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Veterinary Medicine (DVM)	American Veterinary Medical Association Council on Education (AVMA COE)	2021	2028

Administrative Program Accreditation and Certification (https://provost.ncsu.edu/institutional-quality/accreditation/specialized-program-accreditation/)

Division of Academic & Student Affairs (https://dasa.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Academic Skills Enhancement Program within the Academic Support Program for Student Athletes	International Tutor Program Certification within the College Reading & Learning Association (CRLS)	2019	2024
Cooperative Education (On-the-job experience in chosen field)	Council for Cooperative Education	2019	2025
Counseling Center	International Association of Counseling Services, Inc. (IACS)	2015	2023
Student Health Services	Accreditation Association for Ambulatory Health Care (AAAHC)	2019	2022[1]
Student Health Services	Commission on Office Laboratory Assessment (COLA)	2020	2022
UG Tutorial Center Program	College Reading & Learning Association (CRLA) CRLA's International Tutor Program Certification	2019	2024

[1] Site visit scheduled Fall 2022

Environmental Health & Public Safety (https://ehps.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Campus Police	Commission on the Accreditation of Law Enforcement Agencies	2020	2024
Campus Police	International Association of Campus Law Enforcement Administrators (IACLEA)	2020	2024

College of Veterinary Medicine (http://www.cvm.ncsu.edu/)

Program Name	Accrediting Body	Last Yr Accred	Next Yr Accred
Veterinary Hospital	American Veterinary Medical Association (AVMA) performs accreditation inspections	Inspection 2021	Inspection 2028
Lab Animal Facilities	Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) performs accreditation inspections	Inspection 2021	Inspection 2024

Equal Opportunity and Non-Discrimination Policy

It is the policy of the State of North Carolina to provide equality of opportunity in education and employment for all students and employees. Educational and employment decisions should be based on factors that are germane to academic abilities or job performance. North

Carolina State University (“NC State”) strives to build and maintain an environment that supports and rewards individuals on the basis of relevant factors such as ability, merit and performance. Accordingly, NC State engages in equal opportunity and affirmative action efforts and prohibits discrimination, harassment and retaliation, as defined by NC State's Equal Opportunity and Non-Discrimination Policy (POL 04.25.05) (https://policies.ncsu.edu/policy/pol-04-25-05/).[1]

NC State will promptly, thoroughly and impartially respond to all complaints of Discrimination, Harassment and Retaliation.

Any individual with a complaint of Discrimination, Harassment or Retaliation should follow NC State's Discrimination, Harassment and Retaliation Complaint Procedure (REG 04.25.02) (https://policies.ncsu.edu/regulation/reg-04-25-02/) and can file a complaint at http://diversity.ncsu.edu/report-a-concern/.

For more information, please contact:

The Office for Institutional Equity and Diversity
231 Winslow Hall
Box 7530, NC State University
Raleigh, NC 27695-7530
Phone: 919.515.3148
Fax: 919.513.1428
TTY: 919.515.9617
Website (https://diversity.ncsu.edu/)

[1] This policy is established in accordance with 41 CFR Part 60 and is implemented in accordance with applicable laws and their amendments, including but not limited to, Title VI and Title VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Executive Order 11246, the Age Discrimination in Employment Act of 1975, Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act of 1990, the Vietnam Era Veterans' Readjustment Assistance Act of 1974, the Civil Rights Restoration Act of 1988, North Carolina General Statutes Chapters 116 and 126.

Student Activities

At NC State, we are dedicated to providing students with not only a world-class education, but a well-rounded and enriching collegiate experience. Students have the opportunity to take in thrilling arts performances, connect with like-minded peers by joining or beginning any of 700+ student organizations through Student Involvement, or cheer on the Wolfpack with pride as our 23 varsity sports teams take on the competition.

Take a look through the resources below to see just some of the ways that students can get involved and stay active both on and off campus with the Wolfpack community.

The Arts at NC State

NC State University offers a broad range of opportunities for students to experience and participate in the arts – through crafts, dance, exhibitions, music and theatre – open to all students regardless of academic major. Whether through academic courses, co-curricular participation in dance, music and theatre, experiencing performances by professional artists, engaging with powerful exhibitions of visual art, or the thrill of developing crafts skills, the arts offer all NC State students an avenue to develop creative think and do skills. All arts units are housed within University College in the Division of Academic and Student Affairs. For additional information, please visit the arts website (arts.ncsu.edu).

The Crafts Center

Explore your creative side and Make It Here! The NC State Crafts Center is an excellent resource for all students. Whether you're interested in learning a skill or just want to "de-stress," the Center has a comprehensive range of offerings in clay, digital photography, wood, jewelry/metals, fibers, glass, lapidary, mixed media and more. The Crafts Center is a diverse and creative space where skill and self-expression are fostered through the making and sharing of art and craft. Join us for special student-only classes such as Friday CRAFTernoons, Stressbusters and more. It's also a great place to visit, study and surround yourself with creativity. Mentorship thrives at the Center. Professional staff and crafts instructors provide quality technical advice and materials support. With the intent of enhancing quality of life, the Crafts Center reaches out through academic collaboration, support for student life, and partnerships with other arts organizations. Participation in associated crafts guilds that routinely meet at the Crafts Center provides NC State students a creative platform within the university and beyond.

The addition of a digital fabrication makerspace, the C:LAB, has opened new doors for creative exploration and production. Classes in software, technology, laser engraving, and personal/professional development are available to all students to augment their academic engagement.

For answers to your questions about the Crafts Center, please call 919.515.2457 or visit the Crafts Center website (crafts.arts.ncsu.edu) for our upcoming programming, calendar information, map and directions.

Dance Program

The NC State Dance Program gives students the opportunity to study dance through direct experience in choreography and performance. The program's two student companies, the State Dance Company (DAN 295 Problems of Dance Performance) and the Panoramic Dance Project (DAN 210 Current Trends in Afrocentric and World Dance), are open by audition. A vast array of classes, offered through the Master Class Series, are open to all NC State students, faculty and staff. The program also offers other academic courses such as Dance Composition (DAN 272 Dance Composition - Solo Forms), Hip-hop Dance (DAN 260 Hip-hop Dance), and Hip-hop Dance II (Dan 261 Hip-hop Dance II).

The Dance Program provides a rich training ground for choreographers through the study of composition, independent study, and guided choreographic projects. As undergraduate and graduate students pursuing degrees in various fields, the dancers at NC State bring their diverse insights and experiences into the artistic process and contribute meaningfully to the art. The Dance Program's three annual concerts are described below:

- **The Dance Program Fall Concert:** The Fall Concert features the choreography of current students who create work through independent study, as well as guest artists and company directors. Both the State Dance Company and the Panoramic Dance Project are represented on the Fall Concert.
- **State Dance Company Concert:** The State Dance Company performs a distinguished collection of modern dance for their annual concert. The concert features premiere and repertory work created by the dance program directors and invited guest artists.
- **Panoramic Dance Project Concert:** For their annual spring concert, the Panoramic Dance Project presents a variety of dance styles in a world context with a focus on African, hip-hop and Latin dance. The concert features work by the director, guest artists and selected student choreographers.

For more information, please contact 919.515.7034 or visit the Dance Program website (https://dance.arts.ncsu.edu/).

Gregg Museum of Art & Design

The Gregg Museum seeks to inspire creativity, innovation and the expression of ideas. With frequently-changing exhibitions and exciting free programs like films, artist talks, workshops, or yoga nearly every week, there's always something new to see or do at the Gregg. As one of NC State's designated Student Centers, the museum and its surrounding gardens offer a great place to study, have a picnic, or hang out with friends in a stimulating environment. Wifi is available both outdoors and inside.

The Gregg collection includes more than 35,000 objects from every continent, such as ceramics, glass, textiles, furniture, photography, paintings and sculptures, folk and outsider art, works on paper, Native American art, industrial design, archaeological artifacts, and fashion and costume. If you're looking for inspiration or researching a topic involving objects, feel free to approach the museum staff for help. Each semester the Gregg also offers internships (for class credit) and paid student positions that provide experience in museum work.

To schedule tours or class visits, or to plan to use the permanent collection for research, please call 919.515.3503 or visit **Gregg.arts.ncsu.edu (https://gregg.arts.ncsu.edu/)**.

The Gregg is located at 1903 Hillsborough Street, just across Pullen Road from the university's Memorial Belltower, at the northern tip of Pullen Park. Opening hours are 10 a.m. to 5 p.m. Tuesday through Saturday. On certain Thursday nights there are free programs (films, artist talks, performances, etc.) and the museum will stay open additional hours. Check the website (gregg.arts.ncsu.edu) for listings and announcements. The galleries are closed Sundays and Mondays. Admission is free.

Department of Music

The Department of Music provides educational and performance opportunities for student and community participants through a variety of musical experiences and academic courses. Both a 15-hour minor in Arts Entrepreneurship and a 20-hour music minor is offered for qualified undergraduate students who wish to engage in more extensive study of music and the arts. Three tracks are offered: Performance, Composition, and General Studies.

For full descriptions of the academic courses, consult the Department of Music (http://catalog.ncsu.edu/undergraduate/university-college/music/) page in the NC State University Course Catalog, contact 919.515.2981 or visit the Department of Music's website. (https://music.arts.ncsu.edu/)

A wide variety of performing ensembles provide opportunities for students to develop both artistically and intellectually through applied music study. Through performance, the ensembles play an important role in campus life, presenting public concerts and performing at official functions (both on and off campus) and athletic events. Curricular performing ensembles receive one academic credit that may be used to satisfy free elective requirements in any academic major. Membership in most ensembles requires an audition with the instructor. See the Department of Music's website (https://music.arts.ncsu.edu/) for audition information.

- **Choral Ensembles.** The Choral program offers students from all academic areas an opportunity to participate in the exploration and performance of the highest quality choral repertoire from all eras. The ensembles include State Chorale, Tenor-Bass Choir (Singing Statesmen), Soprano-Alto Choir (Vox Accalia), and the African American Choral Ensemble. Performance highlights have included concerts every semester, tours and occasional collaborations with other ensembles.
- **Orchestras.** The Raleigh Civic Symphony and Chamber Orchestra combine student and community musicians with professional leaders to present concerts of innovative programming on campus and in other Triangle area venues. Area professionals serve as concertmaster, principal cellist, and guest coaches, to provide high-level instruction and leadership to community and student players. Both orchestras require an audition.
- **Athletic Bands**. The Marching Band (Power Sound of the South) is active during football season, and the Varsity (Pep) Band is active during basketball season. Students must audition for a band and will be placed according to their ability and interest.
- **Concert Bands.** Two concert bands, the Symphonic Band and the Wind Ensemble, are offered each semester. Students must audition for the Wind Ensemble and will be placed according to their ability and interest.
- **Jazz Ensembles.** The jazz program includes Jazz Ensemble I, Jazz Ensemble II and a variety of Jazz Combos. The jazz groups perform both on and off campus during the fall and spring semesters. Students must audition for a jazz ensemble or combo and will be placed according to their ability and interest.
- **Piano.** Beginning piano classes are offered to students from all academic areas for credit. No previous experience is required. Applied lessons are offered to advanced piano students who have passed an audition and are admitted to the music minor program in piano performance with limited additional openings for non-minors.
- **Voice.** A Vocal Techniques class is offered to beginning voice students for credit with instructor approval. Previous voice study is not required. Applied voice lessons are offered to advanced voice students who have passed an audition and are admitted to the music minor program in vocal performance with limited additional openings for non-minors.
- **Pipes & Drums**. Students may learn to play the bagpipes, an instrument known to many of North Carolina's earliest settlers. Pipes, drums, and other equipment are furnished. Beginning pipe and drum lessons are available to students without previous experience.

NC State LIVE

NC State LIVE is your opportunity to experience boundary-breaking professional dance, theatre, music and multidisciplinary performances. NC State LIVE brings artists from across the world to campus to address the issues of our time with unflinching creativity and humanity. Discounted tickets are available to NC State students, faculty and staff. The NC State community also has the opportunity to engage with world-class artists through free workshops, master classes, artist talks and outdoor concerts. NC State LIVE hires student employees to help with marketing, event management, and artist services. For more information, follow @NCStateLIVE or visit live.arts.ncsu.edu.

University Theatre

University Theatre is NC State's open-access student theatre program, welcoming participation by all students regardless of major. We create an inclusive, student-centered community, grounded in the experience of making and sharing theatre. Through our large productions within our Producing Series, our professional summer TheatreFEST series, and various workshops and master classes throughout the year, students can enjoy theatrical works, learn practical skills, and become compassionate critical thinkers.

University Theatre offers many ways to participate with no prior experience necessary. Opportunities exist in:

- Performance
- Technical theatre
- Scenic, costume, lighting, sound, projection
- Stage management
- Arts administration
- Events
- Front of house operations
- Directing
- Design

Academic classes are offered in conjunction with our theatre minor and numerous workshops throughout the year. Employment opportunities for live events are also offered.

University Theatre is also home to the Psi Kappa cast, a chapter of Alpha Psi Omega national theatre honor society.

Contact: 919.515.3927 or visit the University Theatre website (https://theatre.arts.ncsu.edu/).

Ticket Central

Ticket Central serves as the centralized box office for the performing arts programs at NC State, ticketing events in a variety of performance venues including Stewart Theatre, Titmus Theatre, Kennedy-McIlwee Studio Theatre, and the ballrooms of Talley Student Union. In addition to serving the NC State arts units, Ticket Central provides ticketing services on a fee basis for campus and community organizations. The box office is located in the main lobby of Thompson Hall. Hours vary by semester and during university holidays. Tickets are always available online at tickets.arts.ncsu.edu. Tickets may also be purchased in person, or by phone at 919.515.1100.

Campus Facilities

NC State's campus facilities are home to many of our student activities and events. From screening films in the historic Witherspoon Student Center, joining Student Government meetings in Talley Student Union, participating in intramural sports at the Carmichael Complex, or watching one of University Theatre's plays in Frank Thompson Hall, students and visitors can have a variety of experiences all right here on campus. Here are just a few of the spots that serve our student activities and services.

The Campus Cinema

The Campus Cinema, located in Witherspoon Student Center, presents films ranging from independent works to the latest Hollywood blockbusters in digital format with Dolby® Digital Surround Sound. The Cinema is a fully functional movie theatre with 460 seats and a concession stand offering freshly popped popcorn, one free popcorn per person. Movie screenings are free to NC State and the general public unless otherwise specified. Check out the cinema website at: https://uab.ncsu.edu/films-schedule/ (http://uab.ncsu.edu/films-schedule/). If you desire any assistive devices, services, or other accommodations to participate in these activities, please contact the UAB Films Advisor at 919-515-5168.

Carmichael Complex

Carmichael Complex consists of Carmichael Gym, Carmichael Recreation Center, Willis R. Casey Aquatic Center, Miller Fields, 12 tennis courts, and 8 basketball courts, which offer a wide variety of indoor and outdoor fitness choices for students. Students may use the pools, indoor track, courts, cardio equipment, the outdoor fields, and tennis courts unless otherwise reserved for classes, events or maintenance. The Carmichael Complex is home to University Recreation and the Department of Health & Exercise Studies. For more information, please visit the Carmichael Complex website (http://recreation.ncsu.edu/facilities/carmichael/) or call (919) 515-PLAY (7529).

Gregg Museum of Art & Design

Gregg Museum of Art & Design is NC State's collecting museum, with more than 35,000 examples of contemporary and historic ceramics, textiles, glass, furniture, photography, paintings, sculptures, folk and outsider art, archaeological artifacts, works on paper, and fashion garments preserved in its permanent collection. Frequently-changing exhibitions and interesting programs make every visit special.

Located in the original 1928 Chancellor's Residence at 1903 Hillsborough Street (just across from NC State's famous Memorial Belltower), the Gregg includes period rooms, formal gardens, and a contemporary 15,000 sq. ft. galleries wing. All are used as exhibition and programming spaces, and are free and open to students and public alike.

To schedule tours or class visits, or to make arrangements to use the permanent collection, call 919-515-3503 or visit Gregg.arts.ncsu.edu (https://gregg.arts.ncsu.edu/). Wi-Fi is available both outside and indoors. Hours are 10 a.m. – 5 p.m. Tuesday through Saturday. The galleries are closed Sundays and Mondays. Admission is free.

Price Music Center (PMC)

Price Music Center (PMC) is the location for the Department of Music and its programs. Until 1965, the first Pullen Hall had been the original music building, which, along with many band instruments, pianos, and a music library, was destroyed by a student arsonist. Built in 1971, Price Music Center is named to honor Percy Walter (Daddy) Price, the father of today's musical organizations on campus and the University's first music director in 1923.

Practice studios are available to NC State students on a first-come, first-served basis. Each practice room has an upright piano and music stand. For questions about practice space in Price, call 919.515.2981. For more information, see Department of Music (https://music.arts.ncsu.edu/).

Price Music Center is located at 2620 Cates Avenue, next to the Talley Student Union. The main office is located on the second floor, room 203. Additional facilities and offices are located in the south wing of Broughton Hall.

Talley Student Union (TSU)

Talley Student Union (TSU) is the hub of student life on campus and is the place to study, shop, dine and engage with your peers. Talley Student Union is anchored with nine food venues, Wolfpack Outfitters, the Woodward Student Involvement Center and Stewart Theatre. If students are looking to connect with the arts, enhance their leadership skills, or connect with peers, Talley Student Union is the place to start. Students can even be part of the amazing student employment team that operates the facility.

Program offices and service areas that can be found in the Talley Student Union include:

- Arts NC State;
- Center for Student Leadership,
- Dance Program;
- Ethics & Public Service;
- Fraternity and Sorority Life; GLBT Center;
- Multicultural Student Affairs; Student Involvement;
- NC State LIVE;
- NC State Student Centers Administration;
- Student Centers Board of Directors;
- Union Activities Board;
- University Theatre Administration;
- Women's Center;
- RAVE! Events;

- Ticket Central;
- and University Graduate Student Association.

RAVE! Events

To reserve room in the Talley Student Union or to plan your event, please visit R (http://campusenterprises.ncsu.edu/talley-student-union/)AVE!'s website (https://campusenterprises.ncsu.edu/rave-events/) or contact RAVE! Events at 51-EVENT (513-8368).

Frank Thompson Hall

Frank Thompson Hall is the location for University Theatre and the Crafts Center. Built in 1925 as a gymnasium, Thompson Hall reopened in Fall 2009 after an extensive renovation that was an extraordinary partnership between NC State students, private citizens, businesses and the extended NC State community.

Thompson Hall houses University Theatre's full production activities, performances, and classes. Facilities include the Titmus Theatre, the Kennedy-McIlwee Studio Theatre, the costume shop, the scenic construction and paint shop, lighting and sound facilities, as well as rehearsal and classroom spaces. The renovation brought state-of-the-art technologies and improved accessibility to the building that now returns to its purpose as a hub of student activity. For more information, see University Theatre (https://theatre.arts.ncsu.edu/).

Located on the ground floor of Thompson Hall, the Crafts Center offers technology-rich studios and specializes in classes and workshops in clay, digital photography, wood, jewelry/metals, fibers, glass, lapidary, mixed media and more. For more than fifty years, the Crafts Center has provided a friendly learning environment for students and craftspeople of all levels. NC State's Crafts Center is one of the finest university crafts programs in the country. Classes and studio use are available to NC State students, alumni, employees, and the general public. For information, see Crafts Center (https://crafts.arts.ncsu.edu/).

Thompson Hall is located on Dunn Street and Jensen Drive.

Witherspoon Student Center (WSC)

Witherspoon Student Center (WSC) currently houses the African-American Cultural Center, Student Government and Student Media which includes the offices of five student-run media organizations:

- Agromeck (yearbook);
- The Nubian Message and Technician (newspapers);
- Windhover (literary magazine);
- and WKNC FM 88.1 (radio station).

Witherspoon includes two accessible balconies; one meeting room available by reservation through REM; the African-American Cultural Center's Sankofa Room, Gallery and Library; and Campus Cinema, used for films, lectures, classes and special events.

Intercollegiate Athletics

Go Pack!

NC State has a long and storied history in athletics, as well as a loud and passionate fanbase that supports the Wolfpack faithfully. The university's athletics programs (http://www.gopack.com/) enjoy a tradition of excellence as they compete in the prestigious Atlantic Coast Conference.

The athletics program is self-supporting and is operated primarily through gate receipts, radio and television revenues, NCAA distributions, student fees, and private donations. Funds for athletics grants-in-aid are provided through the North Carolina State Student Aid Association, also known as the Wolfpack Club.

Sports

The Department of Athletics conducts the university's intercollegiate athletics program, which includes 21 varsity sports. The athletics program is administered by the Director of Athletics, Boo Corrigan. The Council on Athletics is appointed by the Chancellor and serves in an advisory capacity to the Director of Athletics and the Chancellor.

Men's varsity sports include soccer, cross country, and football in the fall; basketball, swimming and diving, indoor track, and wrestling in the winter; and outdoor track, golf, tennis, and baseball in the spring. Varsity sports for women include soccer, cross country, and volleyball in the fall; basketball, indoor track, swimming and diving, and gymnastics in the winter; and outdoor track, golf, softball and tennis in the spring. The co-ed rifle team competes during the winter.

Athletics Facilities

The Wolfpack's football facility, Carter-Finley Stadium, boasts 57,600 permanent seats. The 106,000 square-foot Murphy Football Center, which is the operations hub for the football program, stands in the south end zone, while the Finley Fieldhouse houses visitor locker rooms and other operations spaces on the north end of the field. Soaring high above it all is Vaughan Towers, a 117,000 square-foot structure along the west grandstand that houses 955 club-level seats, 51 private luxury suites, a University suite for the Chancellor and a state-of-the-art press box.

The men's basketball squad competes in the PNC Arena, which boasts one of the top capacities in the Atlantic Coast Conference with seating for 19,500 fans. Since PNC Arena opened in 1999-2000, NC State has finished every year in the top-25 nationally in attendance.The women's basketball squad plays in the James T. Valvano Arena at William Neal Reynolds Coliseum – one of nine areas on campus designated as a "hallowed space." The arena has seating for 5,500 in the facility which recently underwent a $35 million renovation and now houses the Wolfpack Walk of Fame and History. It's also the home of gymnastics, wrestling and rifle, as well as NC State's ROTC programs.

Located in the heart of campus, the Dail Soccer Field is located inside Paul Derr Track under stadium lights. Adjacent to that complex is the Dail Softball Stadium. Situated across from historic Reynolds Coliseum, the picturesque campus setting serves as the background for one of the best softball facilities in the ACC.

With seating for 3,480, Doak Field at Dail Park has been the home of Wolfpack baseball for over 50 years. Across the street from "The Doak" is the J.W. Isenhour Tennis Center. The outdoor stadium has six lighted courts, chairback seating for up to 1,000 spectators, and an electronic scoreboard. The indoor courts, named in honor of former Wolfpack standout Andy Andrews, provides seating for up to 200 spectators.

The golf team trains at the beautiful Lonnie Poole Golf Course, an 18-hole, 7,350-yard, par 71 public course located on Centennial Campus. The $11.6 million Arnold Palmer Signature multipurpose golf course also houses a research center and The Carol Johnson Poole Clubhouse.

This facility also supports critical academic programs, including the Professional Golf Management (PGM) and turfgrass programs.

The Willis R. Casey Aquatic Center serves as the hub for the Pack's nationally-ranked swimming and diving teams. The site of many ACC Championship meets over the years, it features two pools and spectacular seating for approximately 1,000 fans.

The Wolfpack's athletics administrative offices and coaches' offices for soccer, track and cross country, and wrestling are located in the Weisiger Brown General Athletics Facility. The Case Athletics Center houses the Academic Support Program for Student-Athletes.

The fundraising offices of the Wolfpack Club and the athletic department's ticket offices are located in the Palisades Building near Carter-Finley Stadium: 5400 Trinity Rd. (Suite 500), Raleigh, NC 27607.

For ticket information call 919.865.1510 or 1.800.310.Pack. The main athletic department receptionist: 919.515.2101. Visit the official athletic department website (http://www.gopack.com/) for complete information.

Student Leadership and Engagement

Student Leadership and Engagement

The Wolfpack's starting place for students to get involved at NC State, **Student Leadership and Engagement** helps students find fun and meaningful ways to make NC State home through involvement on campus. The department supports the Wolfpack's diverse community of student organization members, leaders, and advisors through advising, education, and programming. Student Involvement also provides resources to students that make it easy to find any of over 700 student organizations to join or start an organization that doesn't exist.

Getting involved is an important way students can develop the sense of belonging necessary for academic success, personal and professional development. Being involved on campus is a great way to build a sense of belonging at NC State, increase cultural competencies and develop multiple perspectives, as well develop academically, personally, and professionally.

Student Leadership and Engagement Center
4210 Talley Student Union
2610 Cates Avenue
Raleigh, NC 27695-7295
919.515.2729
ncstate-sle@ncsu.edu

Website (https://sle.dasa.ncsu.edu/)

Student Government

Founded in 1921, Student Government is a student-run organization that serves as the official voice of the student body. The organization attempts to better the student experience at NC State by working alongside university administrators to address student concerns.

Student Government is organized into five primary areas: executive, legislative, judicial, the treasury, and the Board of Elections. Student organizations may seek funding from Student Government appropriations committee through a bi-annual process.

Website

Talley Student Union
Suite 4251
studentgovernment@ncsu.edu

McKenzy Heavlin, Student Body President
Timothy Reid, Student Body Vice President
Miles Calzini, Student Senate President
Harrison Andrews, Student Body Treasurer

The University Activities Board

The University Activities Board (UAB) was formed in 1951 to produce quality programming "for the students, by the students." The mission of UAB is to create innovative activities that stimulate, motivate, educate, and involve the student body. Annual programs include Wolfstock, Pan-Afrikan Week, and TUFFTalks.

Website (https://orgs.ncsu.edu/uab/)
TyDasia Davis, President
Yazmin Sanchez, Vice President

Fraternity and Sorority Life

There are over 50 fraternities and sororities at NC State University, each founded to prepare students for society through a values-based fraternal experience. Affiliation with an organization is designed to empower students to pursue their potential, providing opportunities to belong, give, achieve, live and lead. How organizations enact those values through membership, programs, and activities are what makes each organization unique. Fraternities and sororities provide opportunities to get involved, helping students on a large campus build a support network of peers that share similar goals and interests. Organizations challenge members to take on new responsibilities, develop their leadership potential, be active within the campus and surrounding communities, and adopt a commitment to volunteerism and civic engagement. Fraternities and sororities also provide their members with a unique lifetime membership, connecting them with local graduate and alumni chapters and national alumni groups well after graduation.

Greek Village provides housing to 15 organizations and 526 residents, with six residences in University-owned facilities and nine in privately owned facilities. The Greek Village project is currently in Phase 3 of 5 for planned redevelopment, which is replacing aging infrastructure and aims to provide opportunities for alumni house corporations to design, build, and operate organization-owned housing on campus. A total of 21 building lots will be developed along with 275 additional beds for residents of townhomes and apartments.

Additionally, nine full-time House Directors and five Chapter Resident Directors live on-side to ensure facility safety as well as compliance with university standards.

For more information on membership, educational programming, or service opportunities, visit the Department of Fraternity and Sorority Life's website, the office in 5261 Talley Student Union, or call 919. 513.2910.

Website (https://fsl.dasa.ncsu.edu/)
Shelly Brown Dobek, Director of Fraternity and Sorority Life

Student Media

NC State students have the opportunity to produce and manage a variety of student-oriented media. By working with these media, students gain valuable co-curricular experience in sales, marketing, journalism,

broadcasting, production, design, multimedia communication, leadership and management. NC State offers six media outlets staffed by students and supported in part by self-generated non-fee revenue, as well as a student-staffed Business and Marketing office which coordinates advertising sales, sponsorships and full-service marketing opportunities for all six media. Many staff positions are paid. Visit the department website (https://studentmedia.dasa.ncsu.edu/).

Agromeck

Agromeck, the university's yearbook first published in 1903, provides a record in words and pictures of student and campus activities each year. Student staff members include photojournalists, writers, designers and editors, all with a common mission: documenting the history of the university from the student perspective. The *Agromeck* has received the nation's highest awards for general excellence and photography as well as national Pacemaker and Crown awards from the Associated College Press and the Columbia Scholastic Press Association, respectively.

Nubian Message

Nubian Message provides news and features about the Black community at NC State, as well as coverage of regional, state and national issues of interest to our students. To find out more about this bi-weekly publication, visit the *Nubian Message* online.

Roundabout

Roundabout is a glossy, full-color, general interest magazine printed four times a year. Each edition highlights topics relevant to students during that time of year, such as housing, wellness, and dining and culture.

Technician

Technician, the university's oldest student newspaper, is published each Thursday when school is in session during the fall and spring semesters, and online with breaking news and online-only content year-round. With a print circulation of 3,000 copies at nearly 90 newsstands on and near campus, *Technician* has earned numerous state and national awards for news, features, sports, opinion writing and photography, as well as general excellence. Online, you'll find continuous updates of news, features, sports, campus events, and other content of interest to students, including video, audio and photo slideshows.

Windhover

Windhover, the campus literary and visual arts magazine, is published each spring. As a showcase for NC State's creative writers, poets, artists, photographers and musicians. It has received numerous national awards, including the Pacemaker from the Associated Collegiate Press and Gold and Silver Crown awards from the Columbia Scholastic Press Association.

WKNC 88.1 FM HD-1/HD-2

NC State's student-run radio operates at 25,000 watts to reach a potential audience of more than 1.4 million. This distinction makes WKNC 88.1 FM HD-1/HD-2 one of the largest student-run college radio stations in the United States. It employs a full complement of student managers, music directors, DJs and multimedia content creators to provide radio programming 24/7/365, as well as various online content on its blog, YouTube channel and podcasts. WKNC also sponsors live music events both on campus and at music venues in the Triangle. Visit (and listen to) WKNC.org (http://www.wknc.org/) and on social media @WKNC881.

Student Media Business and Marketing Office

The Student Media Business and Marketing Office gives students interested in sales and marketing an opportunity to hone their skills while earning commission on every advertisement and sponsorship they sell. From print, to broadcast, to online sales, few (if any) organizations at NC State offer our students a better way to build their "real-world" business and marketing acumen as they work toward earning their degree from NC State. To find out more, visit the Business and Marketing Office online (https://studentmedia.dasa.ncsu.edu/advertising/).

The Student Media Board of Directors

The Student Media Board of Directors (https://studentmedia.dasa.ncsu.edu/board/) is a way for students to get involved in the management of a large business operation. The Board of Directors is the governing arm for all student media which use student fee monies to support their operations. Elections to the Board are held in the spring.

Student Services

NC State University knows that there's more to academic success than books and research papers. That's why we offer a full range of services to support students in all aspects of their academic careers. Our full-service Student Health Center helps keep students healthy, while our Career Development Center helps them plan for life after graduation. Take a look through all of our student services below to see how we are here to support your time at NC State.

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Academic Advising Programs and Services

Academic Advising Programs and Services (AAS) provides quality and timely advising services to students and faculty to facilitate academic success, major selection, career development, and personal enrichment. Current or former NC State undergraduate degree students in transition are the priority population for AAPS. AAPS is a collaborative of cross-curricular professional advisors who partner to provide walk-in, face-to-face, and virtual advising to undergraduate students exploring majors; current information on General Education, declaring majors & minors, and academic policies; and advising support and development to faculty and staff across the campus.

2751 Cates Avenue
Holmes Hall
NC State Box #7925
Raleigh, NC 27695-7925
Phone: 919.515.8130
Fax: 919.515.8267
Website (https://advising.dasa.ncsu.edu/)

Pre-Professional Programs

Pre-Law Advising

Law schools neither prescribe nor recommend a particular undergraduate curriculum for prospective candidates. A student may prepare for law school within any of the majors offered by the nine undergraduate colleges. Pre-Law Services at NC State are offered through the Career Development Center (http://careers.ncsu.edu/). Through Pre-Law Services, students receive guidance on preparing for law school, taking the LSAT, and applying to law school. Students have the opportunity to learn and network through experiential learning programs, internships, seminars and workshops, and the annual Law School Fair.

The Pre-Law Advisors also works with the Pre-Law Students' Association (PLSA), which is open to all interested students. During the year the PLSA provides programs that have included: NC State Law School Fair, local attorneys, panel of Law School students, Law School Directors of Admission, information on the admissions process. For more information, visit prelaw.dasa.ncsu.edu

Health Professions Advising

Many NC State undergraduate students are planning a career in the health professions and will apply to attend medical, dental, optometry or other health care graduate schools after graduation. **Health Professions Advising** at NC State University offers guidance, information, and support to students interested in attending health professional school. The Health Professions Advisor can assist you with:

- Prerequisite course selection
- Becoming a competitive candidate
- Selecting potential health professions schools
- Application materials & timelines

- Personal statement assistance
- Interview tips & preparation

Health professional schools do not require students to obtain a designated “Pre-Health” degree. Instead, they seek students who have demonstrated academic success and who also have excelled in other areas including clinical and service experience as well as social development. Like most schools, NC State does not offer a dedicated “Pre-Health” curriculum. Instead, we recommend that students interested in health professions select the academic major that is of greatest interest to them while ensuring that they select courses that provide a strong foundation in the natural sciences required by most professional programs for admission. These include biology, chemistry, physics, and calculus along with recommended courses like genetics and biochemistry. It is also recommended that students select courses that improve communication and writing skills as well as provide a strong foundation in the humanities, psychology and ethics.

For more information on Health Professions Advising, visit the Health Professions Advising website (https://prehealth.dasa.ncsu.edu/).

Veterinary Professions Advising Center (VetPAC)

The Veterinary Professions Advising Center (VetPAC) aims to provide NC State students and alumni the guidance, resources and experience necessary to become uniquely competitive veterinary school applicants. While there is no formal "pre-veterinary" program or degree at NC State, many students interested in pursuing veterinary school often declare majors in the following disciplines: Animal Science, Zoology, Biological Sciences, Biochemistry, Microbiology, and Poultry Science.

VetPAC is housed within the College of Agriculture and Life Sciences. For more information on pre-veterinary advising, visit the VetPAC website (https://cals.ncsu.edu/vetpac/).

Academic Success Center

The Academic Success Center provides free academic assistance to NC State undergraduate students enrolled for credit in many challenging 100- and 200- level math, physics, and chemistry classes as well as introductory accounting, biology, statistics, and economics classes. Several types of assistance are available that are designed to best meet the students’ needs, including 1:1 appointment tutoring, group tutoring, drop-in tutoring, and Supplemental Instruction (SI). In addition, writing consultations are available to both undergraduate and graduate students to provide assistance at any stage of the writing process in the English language. Academic peer mentoring is also available to students wishing to work on general academic skills such as note-taking, time management, and test preparation.

Students are eligible to become a tutor or mentor for the ASC if they have an established GPA of 3.25 or better and at least a B+ in the course(s) they wish to tutor. All new student employees are required to take USC 210 during the first semester of employment to learn techniques designed to help students become independent learners.

Contact

Barbara B. Windom
Director
2200 D. H. Hill Jr. Library
2 Broughton Drive
NC State Box 7118
Raleigh, NC 27695-7118
919.515.3163
Website (https://asc.dasa.ncsu.edu/)

Academic Support Program for Student Athletes

The Academic Support Program for Student Athletes (ASPSA) is a comprehensive support program that strives to meet the academic, personal and professional development needs of all student-athletes, promoting excellence and effectiveness in undergraduate and graduate education as well as leadership and civic engagement.

ASPSA is committed to extending the educational experience of its constituency with particular emphasis on empowering student-athletes to become strong self advocates, providing specialized initiatives to facilitate a smooth transition from high school to college and from college to professional life while successfully integrating student-athletes into the campus community; enhancing academic skills for student-athletes at all skill levels and providing academic support personalized to the needs of each student-athlete.

ASPSA will maintain a strong sense of integrity and will continue to strive to be one of the benchmark programs for academic support for all collegiate academic support programs in the nation.
The mission of the Office of Academic Support Program for Student Athletes at NC State University is:

1. to support the recruitment, retention and graduation of NC State student-athletes;
2. to provide a comprehensive support system that affords NC State student-athletes equitable opportunity to pursue academic, personal, and professional development and
3. to strongly adhere to the principles of integrity, excellence, and lifelong learning.

Contact

Katie Graham
Assistant Dean
200 Case Academic Center
240 Jeter Drive
Campus Box 7104
Raleigh, NC 27695-7104
Phone: 919.515.2464
Fax: 919.515.1619
Website (https://aspsa.dasa.ncsu.edu/about/)

Campus Community Centers

NC State's Campus Community Centers are proudly comprised of the African American Cultural Center, the GLBT Center, Multicultural Student Affairs, and the Women's Center.

African American Cultural Center

The mission of the **African American Cultural Center** is to promote awareness of and appreciation for African American and other African descent experiences through activities and events that enhance academic excellence and strengthen cultural competence for the campus and surrounding communities. Students, staff and visitors are welcome

to attend our programs and events and to visit the Art Gallery and Library in Witherspoon Student Center, the first building on NC State's campus named for an African American, Dr. Augustus M. Witherspoon.

To learn more about the African American Cultural Center, visit our website (https://diversity.ncsu.edu/aacc/). Our main office is located on the 3rd floor of Witherspoon Student Center.

African American Cultural Center
355 Witherspoon Student Center
aaculturalcenter@ncsu.edu

GLBT Center

The mission of the **NC State GLBT Center** is to engage, develop and empower members of the gay, lesbian, bisexual and transgender communities and their allies. To fulfill that mission, we help students connect to form social support networks; offer identity-based and health-related information and resources; consult with students individually and collectively on issues related to personal identity and academic success; refer students to a wide variety of resources on campus and in the local community; provide professional and leadership development opportunities; and host educational events and programs.

Our vision is of a campus where students, staff, faculty and alumni feel a shared responsibility to increase their individual understanding of and comfort with diversity, to enhance their ability to connect with members of their own communities, to build coalitions across identity groups and to work collaboratively to raise awareness, promote respect and create a culture where they can advocate for equity, inclusion and social justice on behalf of themselves and others.

For more information about our educational workshops, events, student organizations, resources or support services, visit our website (http://www.ncsu.edu/glbt/). We are located on the 5th floor of Talley Student Union.

GLBT Center
5230 Talley Student Union
glbtcenter@ncsu.edu

Multicultural Student Affairs

Multicultural Student Affairs researches, designs and implements programs that promote the academic success, retention and graduation of students, with an emphasis on students from historically underrepresented and marginalized ethnic populations. Our programs and services aim to expand students' horizons while honoring their respective cultural experiences.

Multicultural Student Affairs collaborates with many university organizations to conduct programs to enhance personal, professional and cultural development and student success. Programs and services have included orientation symposia, peer mentoring, heritage month programming, cultural celebrations, academic recognition programs, student leadership development, recruitment and advising.

We welcome any NC State student to our programs and services. Visit our website (https://diversity.ncsu.edu/msa/) for more information. We are located on the 4th floor of Talley Student Union.

Multicultural Student Affairs
4261 Talley Student Union
multicultural@ncsu.edu

Women's Center

The mission of the **Women's Center** is to build and create a community of authentic and engaged allies and leaders to pursue gender equity and social justice; enhancing the campus climate through education, advocacy, support and leadership development.

The Women's Center provides leadership opportunities through programming initiatives such as Feminist Fridays, the Women of Color Retreat, The Movement peer educators, alternative service break trips, and volunteer and internship opportunities. Staff in the Women's Center also serve as direct advocates for survivors of interpersonal violence.

The NC State Women's Center serves students of all gender identities, gender expressions, and sexual orientations. To learn more about the Women's Center visit our website (https://diversity.ncsu.edu/womens-center/). We are located on the 5th floor of Talley Student Union.

Students can speak with an advocate by stopping by the center:

Women's Center
5210 Talley Student Union
womens-center@ncsu.edu

Women's Center Hours
Monday - Friday: 9 a.m. - 4 p.m.

24-Hour Sexual Assault Helpline
919.515.4444
ncsuadvocate@ncsu.edu

*See also **Office for Institutional Equity and Diversity** under the University Administration section for other units within this office dedicated to diversity, equity and inclusion at NC State.*

Career Development Center

The **Career Development Center's** mission is to prepare and empower students to identify and pursue their career goals. From first year students to graduate students, services are designed to meet the needs of students across all stages of career development. Career coaches are available to meet with students one-on-one or in group settings. Students are provided access to career related assistance ranging from resume development and interview strategies to job search techniques and experiential learning opportunities.

The Career Development Center's online career tool, ePACK, allows students to search and apply for co-op's, internships, and full-time jobs, schedule an appointment with a career counselor, schedule on-campus interviews with employers, find career fairs, and search for career-related events and activities. A wealth of career information is available on the Career Development Center's website (http://careers.dasa.ncsu.edu/).

Career Development Center
2100 Pullen Hall
201 Dan Allen Dr
Campus Box 7307
Raleigh, NC 27695-7303
919.515.2396
career-development@ncsu.edu

Arnold Bell, PhD., Executive Director

College Advising Corps (CAC)

The College Advising Corps is a nonprofit AmeriCorps program that assists low-income, first-generation college, and underrepresented students from rural North Carolina navigate the process of finding postsecondary programs that are the best academic, financial, and personal fit for them.

The College Advising Corps at NC State launched in 2014-2015 as the result of a generous gift from the John M. Belk Endowment. The program currently serves 21 high schools across 11 NC counties (Bladen, Duplin, Franklin, Granville, Martin, Moore, Pender, Perquimans, Pitt, Washington, Wayne).

AmeriCorps College Advisers support students through college exploration, admissions, and financial aid processes. Advising Corps Members meet with students, collaborate with high school teachers and staff, and plan events throughout the year to create and promote a college-going culture within the community.

Visit our website (https://advisingcorps.dasa.ncsu.edu/) to learn more about our program.

Contact

Nicole Ditillo
Program Director
204 Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Phone: 919.515.5247
Fax: 919.515.4416
Website (http://advisingcorps.dasa.ncsu.edu/)

College Advising Corps (CAC)

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Contact

Nicole Ditillo
Program Director
204 Park Shops
NC State Box 7105
Raleigh, NC 27695-7105
Phone: 919.515.5247
Fax: 919.515.4416
Website (http://advisingcorps.dasa.ncsu.edu/)

Counseling Center

NC State and the **Counseling Center** work hard to create a campus culture that supports and connects us all. College is a time for tremendous intellectual, social and professional growth. But as we create leaders and innovators, we also want to cultivate emotional and psychological growth that will allow our students to be successful and flourishing.

The Counseling Center provides individual and group counseling for NC State students wishing for assistance with personal, academic or career concerns. Services are primarily short-term in nature and referrals are made as appropriate. Counseling staff includes psychologists, professional counselors, social workers, graduate interns and psychiatrists who are available to work with students with concerns such as anxiety, depression, relationship issues, substance abuse, test anxiety, time management, dissertation support, and choosing a career. All counseling is strictly confidential with exceptions noted on the Counseling Center website. In addition to counseling, workshops and support groups are offered throughout the year in a variety of areas such as time management, stress reduction, suicide prevention, and relationship skills.

The Counseling Center is located on the 2nd floor of the Student Health Center, 2815 Cates Avenue. Appointments may be scheduled by coming by the Counseling Center during walk in hours daily as posted on our website. Emergency after-hours assistance is available by calling the Counseling Center at 919.515.2423 and selecting the Counselor on Call. Additional information about services can be found on the Counseling Center's website (https://counseling.dasa.ncsu.edu/).

The Counseling Center is accredited by the International Association of Counseling Services (http://iacsinc.org/).

Student Health Center
2815 Cates Avenue
Raleigh, NC 27695-7312
919.515.2423
919.515.8525

Monica Osburn, Executive Director and Licensed Clinical Mental Health Counselor Supervisor

Disability Resource Office

The **Disability Resource Office (DRO)** facilitates accommodations and services for individuals with documented disabilities and serious medical conditions. Accommodations and services are rendered based on the individual's documented needs and are determined through an interactive process. DRO will maintain appropriate confidentiality of records and communication regarding disability. To receive accommodations and services, please contact the DRO as far in advance as possible.

In accordance with Section 504 of the Rehabilitation Act of 1973 ("Rehab Act"), the Americans with Disabilities Act of 1990 ("ADA"), The ADA Amendments Act of 2008 ("ADAAA"), and state law, NC State is committed to ensure that no qualified individual with a disability in the United States shall be excluded from, denied the benefits of, or be subjected to discrimination under any program or activity. The DRO

works diligently to ensure that individuals with disabilities are provided an inclusive experience and equal opportunity by determining eligibility for accommodations for students with disabilities and serving as a resource to faculty in helping them understand their obligation in providing equal access.

Visit The Disability Resource Office online (http://dso.dasa.ncsu.edu/) for more information about services, student and faculty rights, and other resources.

Holmes Hall, 3rd Floor
2751 Cates Avenue, Suite 304
NC State Box 7509
Raleigh, NC 27695-7509
Phone (voice): 919.515.7653
Phone (TTY): 919.515.8830
Fax: 919.513.2840
disability@ncsu.edu
Website (http://dro.dasa.ncsu.edu)

Military and Veteran Services

NC State University **Military and Veteran Services (MVS)** is the university's centralized resource to coordinate integrated support to military-affiliated students. Our primary objective is to ensure that our veterans and military-affiliated students feel a strong sense of belonging to NC State.

Mission

NC State University is committed to educating, supporting, and honoring student veterans and their families by helping them acquire the knowledge and skills necessary to achieve their personal and professional goals.

The MVS proudly serves all military-affiliated students, staff, faculty and retirees:

- Discharged and retired veterans
- Active duty military
- Members of the National Guard and Reserve Components
- Spouses and dependents of military and veterans
- Gold Star family members

The goal of the MVS is to ensure you are successful as you:

- Transition from the military to the campus;
- Persist to graduation; and
- Transition from NC State into your chosen career

For more information about our services and resources, visit our website (https://veterans.dasa.ncsu.edu/).

NC State Military and Veteran Services
100 Witherspoon Student Center
2810 Cates Ave.
Campus Box 7318
Raleigh, NC 27695-7318
919.515.5041
ncstatevets@ncsu.edu

Nick Drake, Director

NC State Dining

NC State Dining's award-winning program offers food options that are convenient, fresh, wholesome and delicious. We have over 40 dining locations across campus, all of which accept some form of the meal plan. From traditional all-you-care-to-eat dining halls to a mix of restaurants, cafes and convenience stores, our program is designed to meet the unique needs and tastes of the campus community.

NC State Dining hosts a number of theme meals and monotony breakers during the year, including our famous All Carolinas Meal, which features items grown or produced in North Carolina. We also host a number of cultural meals, too. Check out the special events calendar (http://www.ncsudining.com/university-dining-events/) for more details.

Nutrition

We understand the diverse nutritional needs of our campus population, such as food allergies, intolerances, and special dietary preferences. Our website (https://dining.ncsu.edu/locations/) provides nutritional information for all of our restaurants and dining halls, and many locations have a nutrition kiosk where guests can check the daily menu for allergens and other key ingredients.

Our Well-Fed Wolfpack nutrition team and registered dietitian are nationally recognized for their efforts to make NC State one of the best campuses known for its nutrition and wellness programs (http://www.ncsudining.com/campus-dining/healthwellness/). Our dietitian is available for a free consultation to discuss your nutrition goals and special dietary needs. We place a special emphasis on fresh foods and wellness while providing nutrition resources, education, and awareness across campus.

These efforts have helped us earn national recognition, including the Top 26 Healthiest Colleges and Top 10 Gluten Free Accommodating Colleges in the nation.

Meal Plans

All first-year students living on campus are required to have a meal plan.

Our meal plans (https://dining.ncsu.edu/meal-plan-options/) are designed to cover the cost of meals and snacks in three different ways: Dining Hall Swipes, Meal Credits, and Dining Dollars.

- **Dining Hall Swipes:** Just one swipe at our dining hall locations and you can enjoy a full meal or a light snack, all with a single swipe.
- **Meal Credits:** Use Meal Credits to purchase a meal at one of our many restaurants or cafes. Meal Credits are also used to purchase a dining hall take-out meal. Meals Credits vary by location and only one Meal Credit can be used per meal period.
- **Dining Dollars:** Use Dining Dollars at convenience stores and vending machines, or to make small purchases at a restaurant or cafe in lieu of a Meal Credit.

Our **Flex Plans** (Flex 500 Plan and Flex 800 Plan) are primarily designed for students who desire to have the majority of their meals covered by a convenient, affordable campus dining plan. All three plans include all-day access to our dining halls, so students can come and go when they're hungry to our three all-you-care-to-eat dining halls and enjoy a full meal or light snack as often as they like throughout the semester. (The all-access pass requires 30 minutes pass between each Dining Hall Swipe.)

We also have **Block Plans** (Block 80 and Block 120) available. They can be used at any time in the dining halls and includes 500 or 600 Dining Dollars. Our **Commuter/Apartment Plan** is for students who commute or live in on-campus apartments. It includes 850 Dining Dollars that can be used at any dining location and comes with a 5% discount t the register on all purchases.

Picking a Plan

Detailed information and a full guide on selecting a plan is available on our website at dining.ncsu.edu. We recommend you review the plans, then consider your expected daily travel and eating patterns once you've received your residence hall assignment and course schedule. Once you've picked a plan, register online (https://dining.ncsu.edu/meal-plan-options/meal-plan-signup/) or complete the paper form you'll receive in your packet before you arrive on campus this fall. You can then try out your plan and make any changes via our website prior to September 12. Be sure to re-evaluate for the spring semester to ensure your plan is the right one for you and make any changes by January 25.

We're Here for You

We take pride in offering quality food and services designed specifically to meet the wants and needs of students. For more information, visit NC State Dining online (http://dining.ncsu.edu) or call 919.515.3090. Follow us on Facebook (https://www.facebook.com/ncstatediningpack/), Twitter (https://twitter.com/ncstatedining/) and Instagram (https://www.instagram.com/ncstatedining/) for information on special events, featured menu items, cooking demos, and more.

NC State Stores

Wolfpack Outfitters

Wolfpack Outfitters (the NC State Bookstore) has been the authority on textbooks, school supplies, computers and apparel since our founding in 1954. Wolfpack Outfitters ensures students have access to the best prices and service to secure course materials through price comparison tools and easy on-campus shopping. They also offer the most extensive collection of officially licensed merchandise available anywhere.

Shop online or find out more on our website (https://shop.ncsu.edu/).

Locations

Wolfpack Outfitters is the flagship location, located in Talley Student Union. The store carries fan gear, apparel, gifts, books, novelty items, school supplies, technology and more.

Wolfpack Outfitters also services students on Centennial Campus with a smaller satellite location that carries books, school supplies, apparel and snacks. It is located in Wolf Ridge Apartments next to On the Oval Culinary Creations.

Textbooks

Once a student has completed course registration, they can view their book list from their Class Schedule page in MyPack Portal. From there, students can view all required and recommended course materials, compare prices with the online shopping tool, and place an order.

Wolfpack Outfitters prides itself on the value it provides, and it is backed up with pricing transparency. NC State stores also offers a textbook buy-back program at the end of each semester, and students can visit our website to check their value before bringing them in.

Financial Aid and Scholarship Funds

Wolfpack Outfitters will defer payment of online and in-store textbook orders for students who receive financial aid or academic scholarship funds. These charges will be sent to the University Cashier's office for processing upon disbursement of funds. Only items fulfilled by NC State Bookstores are eligible for this payment method at checkout. Students who receive athletic scholarships or sponsorship (VA, VR, WIA, Services for the Blind) should make all purchases in the store.

Laptops

The Technology Department offers business class computers that meet the specifications for all areas of study at NC State. All computers sold at the NC State Stores meet or exceed the university-set recommendations, and are guaranteed to last through all four years of college.

By purchasing from Wolfpack Outfitters, students are guaranteed to receive the convenience of full warranty support on campus.

Contact

Wolfpack Outfitters
Talley Student Union
2610 Cates Ave, Suite 2210
Raleigh, NC 27607
919.515.2161
bookstore@ncsu.edu

Wolfpack Outfitters, Centennial Campus
1910 Entrepreneur Dr, Suite 780A
Tower Hall Annex
Raleigh, NC 27606
919.515.1389

Wolf Xpress
Talley Student Union
2610 Cates Ave, Suite 2260
Raleigh, NC 27607
919.515.7272
wolf-xpress@ncsu.edu

New Student Programs (NSP)

New Student Programs (NSP) addresses the holistic needs of each new NC State student to create a foundation of success.

Based on the core value that people matter, we achieve this through:

- Cultivating strategic partnerships across the University
- Promoting an environment of personal responsibility
- Fostering inclusivity through a shared campus identity
- Partnering with parents and families
- Preparing and empowering student leaders to serve the campus
- Striving to be innovative in meeting the needs of our community

New first-year, transfer, and international students can visit our website (https://newstudents.dasa.ncsu.edu/) to view new student checklists, learn about orientation, explore pre-semester programs, and view other

resources for how to connect with the Wolfpack before arriving on campus.

Contact

3219 Broughton Hall
NC State Box 7525
Raleigh, NC 27695-7525
919.515.1234
new-students@ncsu.edu
Website (https://newstudents.dasa.ncsu.edu/)

Michael Coombes, Director

Office of International Services

The Office of International Services (OIS) is charged with meeting the immigration advising and cross-cultural programming needs for the university's more than 4000 international students and 700 J-1 Exchange Visitor scholars who come from more than 120 different countries. Services provided by OIS include advising students and scholars on immigration regulations and university policies; authorizing certain types of on or off-campus employment authorization for F-1 and J-1 visa holders; and providing cultural programs designed to enrich the cultural and academic experience of the campus community. OIS programs include: New International Student Orientation, Culture Corps, ISSERV service learning program, English Conversation Club, and many others. New international students are required to participate in New International Student Orientation. OIS also provides opportunities for U.S. students to get involved in the international community at NC State by inviting participation in various cross-cultural programs such as volunteering at the International Student Orientation and English Conversation Club.

International applicants must apply to the Admissions Office by the stated deadlines and must meet all the necessary requirements for admission. In addition, international applicants must meet certain language and financial criteria (see the TOEFL and Financial Information sections under Freshman Admission).

The North Carolina Global Training Initiative (GTI) sponsors several short-term certificate, internship, and research programs that international students may be interested in. These full-time non-degree study programs allow international students to study at NC State for one semester in order to learn about U.S. culture and education, improve their conversational English, take undergraduate courses in their field of study back home or in preparation for admission to a degree program here in the U.S., and experience life in the U.S. These programs have a later application deadline and are great for students to take before enrolling in an undergraduate or graduate degree program in the US or for siblings and friends of current degree-seeking students who want to study in the US together.

International students may be interested in joining the GTI's Cultural Exchange Network (CENet). CENet connects NC State's domestic and international students through joint participation in social, academic, and service learning events and workshops. Visit the CENet website (https://getinvolved.ncsu.edu/organization/cenet/) for more details about the program and how you can apply.

Anyone interested in the GTI's programs can visit us on the website (https://gti.ncsu.edu/) for more information.

Outline of minimum immigration requirements for F-1 and J-1 students:

- Keep passport and I-20 or DS-2019 current
- Maintain full-time enrollment every semester (12 hours/semester for undergraduates)
- Make good academic progress toward your degree
- Do not work or intern off campus without prior written approval from OIS
- Do not work on campus more than 20 hours in any one week during the semester
- Update any address change in MyPack Portal within ten days of moving
- Update OIS immediately of any changes in name, funding, or visa status
- Consult with an OIS advisor **before** changing curriculum/majors, withdrawing, dropping below full-time, transferring to another school/program, etc.
- Purchase and maintain the NC State University approved Health and Accident Insurance or other insurance plan that meets the published minimum coverage requirements.
- Keep your valid passport and recently signed visa certificate (I-20 or DS-2019) with you when you travel abroad. Consult with an OIS advisor about visa and travel questions

Further information about immigration requirements, employment and travel questions, cultural opportunities, and other critical information designed to assist international students are detailed on the OIS website. For individual advising, please call (919) 515-2961 to make an appointment with an advisor or stop by during our walk-in hours of 10:00am-11:45am and 1:00pm-2:45pm on Monday, Tuesday, Thursday and Friday (no walk-ins on Wednesdays).

Office of International Services (OIS)
111 Lampe Drive
Campus Box 7222
NC State University
Raleigh, NC 27695-7222
919.515.2961
ois@ncsu.edu
Website (http://internationalservices.ncsu.edu/)

Prevention Services

NC State Prevention Services believes that information should be shared from an objective and factual perspective, without bias or an agenda to steer an individual in any one direction unless imminent harm would result. Prevention Services is a no-cost service to all students and offers consultation to parents of students, staff, and faculty. We are flexible in format and willing to work with you, your group(s), and/or your department in some of, but not limited to, the following ways:

- one-on-one conversations focused on resources
- formal/informal presentations and trainings
- formal/informal conversation facilitators
- staff/student group meeting guests
- Q & A resource
- student group leadership trainings/discussions
- event planning for risk management and problem prevention

CARES: Student Behavioral Case Management

The **CARES** case managers at NC State work collaboratively with campus resources to provide support for students who are in distress or crisis or who are identified as exhibiting concerning or worrisome behaviors. Effective case management ensures that the community at large remains supported and safe while the student involved gains the necessary resources to remain successful academically and personally at NC State. Services include:

- Providing comprehensive outreach and consultation services to the NC State community in order to proactively identify students with concerns
- Providing early intervention and behaviorally based assessments to determine appropriate resources and referrals to campus and community resource
- Working constructively with students to foster resilience and self-advocacy
- Monitoring student progress

Learn more about CARES: Student Behavioral Case Management on our website (https://prevention.dasa.ncsu.edu/nc-state-cares/about/).

Alcohol and Other Drug Prevention Education

Alcohol and Other Drug Prevention Education (AOD) strives to create and sustain a caring community that prepares students to succeed academically, professionally, and personally as well as to become informed, engaged, and productive citizens by reducing the potential unwanted results of substance misuse. Services include:

- Providing alcohol education programming to all first-year students prior to arriving at NC State
- Consulting with campus partners, students, alumni and faculty regarding AOD topics including risk management and prevention
- Providing training for the campus community on harm reduction strategies
- Administering BASICS (Brief Alcohol Screening and Intervention for College Students)

Learn more about Alcohol and Other Drug Prevention Education on our website (https://prevention.dasa.ncsu.edu/alcohol-prevention/about-aod/).

Suicide Prevention

Suicide Prevention efforts at NC State work to minimize identified risk factors and increase protective factors related to suicidality. This includes increasing social connectivity on campus through increasing awareness of campus resources and large-scale outreach efforts. In addition, we work to increase broad ownership across campus for suicide prevention by educating students, faculty, and staff regarding how to recognize when a person is exhibiting signs of suicidal ideation or intent and how to successfully intervene. We also work to decrease stigma around suicide and mental health help-seeking behavior through increasing awareness of the commonality of painful experiences, empowering Mental Health Ambassadors, and creating videos related to personal student stories. Suicide Prevention Services also offers support to those impacted by the loss of a community member to suicide.

Services include:

- Providing QPR (Question, Persuade, and Refer) Suicide Prevention Training
- Creating and collaborating large scale campus events focused on suicide prevention and mental health awareness
- Developing and providing programming for faculty and staff focused on early intervention
- Supporting the Division of Academic and Student Affairs' post-vention efforts following tragic events involving students, faculty or staff

Learn more about Suicide Prevention on our website (https://prevention.dasa.ncsu.edu/suicide-prevention/about-suicide-prevention/).

NC State Prevention Services

2101 Student Health Center
2815 Cates Avenue
Raleigh, NC 27695
919.515.4405
prevention-services@ncsu.edu

Student Health

At NC State we believe in enhancing both students individual health and the overall health of our campus community. With an understanding that Wellness is the interdependent and interactive combination of love for what is done each day, the quality of relationships, the security of finances, the vibrancy of physical health, and the pride taken in what is contributed to our communities. **Student Health Services** is at the cornerstone health and wellness on campus and offers non-urgent medical care and health prevention to students as an outpatient center. We are staffed by board certified physicians, nurse practitioners, physician assistants, registered nurses and other medical support professionals. Some of our services include primary care, gynecology services, physical therapy, nutrition counseling, pharmacy, and specialty services with local dentists, orthopedists, and gastroenterologists.

Student Health is accredited by the Accreditation Association for Ambulatory Health Care, Inc (http://www.aaahc.org/) (AAAHC) and Commission on Office Laboratory Accreditation (http://www.cola.org/) (COLA).

To learn more about the many services and benefits we offer students, visit our website (https://healthypack.dasa.ncsu.edu/).

Hours of Operation

Student Health Services on Main Campus operates on the following hours:

- Monday: 8 a.m. - 5 p.m.
- Tuesday: 9 a.m. - 5 p.m.
- Wednesday: 8 a.m. - 5 p.m.
- Thursday: 8 a.m. - 5 p.m.
- Friday: 8 a.m. - 5 p.m.
- Saturday: 9 a.m. - 12 p.m. (During fall and spring semesters, excluding breaks, for illness and injury)
- Sunday: Closed

Student Health Services on Centennial Campus is our newly opened location in Plaza Hall on Centennial Campus. For hours of operation, please check our website.

Physical Therapy on Main Campus allows appointments during the following hours during the fall and spring semesters:

- Monday: 8 a.m. - 5 p.m.
- Tuesday: 9 a.m. - 5 p.m.
- Wednesday: 8 a.m. - 5 p.m.
- Thursday: 8 a.m. - 5 p.m.
- Friday: 8 a.m. - 2 p.m.
- Saturday: Closed
- Sunday: Closed

A nurse advice line is available at all other times to assure students receive qualified nurse and medical advice. During adverse weather, students should check the Student Health Services website (https://healthypack.dasa.ncsu.edu/) for any variance in operating hours.

Summer session hours are Monday through Friday, 8 a.m. to 5 p.m. with **no weekend hours.** We accept patients for care up to 4:20 p.m to provide sufficient time for you to see your healthcare provider.

Patient appointments are typically 20 minutes.

How to Schedule an Appointment

Appointments can be scheduled online, via the HealthyPack Portal (https://sso.medicatconnect.com) or by calling Student Health Services at 919.515.2563.

Charges

All registered students pay a health fee which provides access to care and covers most, but not all, office visits for provider services. There are charges associated with x-rays, lab tests, allergy injections, travel vaccines, physical therapy, annual physicals, some office visits and specialty clinics. Students are responsible for the cost of prescriptions and over the counter medications /supplies available at the Student Health Pharmacy, as well as expenses incurred when referred to an off-campus laboratory, physician, hospital or pharmacy. Student Health Services will file most insurances on behalf of the student for services and prescriptions received at Student Health. Charges not covered by insurance may be transferred to the student's account with University Cashiers Office. *Check with us prior to your visit to determine if your insurance plan is considered in-network.*

Student Health partners with several specialty groups to offer on campus care. Specialists include Dermatology, Orthopedics and Gastroenterology. Insurance is filed by the specialty group and not Student Health. *Check with the specialty group prior to your visit to determine if your insurance plan is considered in-network.*

Student Health, in partnership with Campus Smiles Dental Services, provides comprehensive dental care to students. Campus Smiles accepts most dental plans and will file your insurance for you. Cash discount pricing is also available. To make an appointment, contact Student Health and ask for the dental clinic. Two locations are available for your convenience - Main Campus and Centennial Campus.

Staying Healthy and Well

As a part of our mission, Student Health not only provides high quality health care but also a comprehensive disease prevention and health education program to the NC State community. Our outreach health educator and Pack Peer Educators offer a variety of information, programs and services to students on issues facing today's young adults. Health topics include nutritional counseling, alcohol and drug education, healthy sexuality, women's health, men's health and much more.

Pack Peers is our student volunteer program that includes two tracks: Track I- Peer Education and Track II- Clinical Experience. Students interested in becoming engaged in our Pack Peer program should visit our website (https://healthypack.dasa.ncsu.edu/) for more information.

Required Medical Insurance

As mandated by the UNC System, NC State University **requires** all undergraduate students taking 6 or more credit hours to have and show evidence of a creditable health insurance policy. **Students failing to provide proof of coverage by the published deadline each semester will automatically be enrolled in and *billed for* the university-sponsored health insurance plan through Student Blue**. Note: This is a University requirement.

The University-sponsored health insurance plan (Student Blue) has a robust set of benefits at an affordable premium. Each year, complete information is available to students at the start of the fall and spring semesters. For more information regarding the health insurance requirement and/or the University-sponsored health insurance plan, go to our website (https://healthypack.dasa.ncsu.edu).

Confidentiality

All health and medical information is kept secure and confidential and is not divulged to anyone without the express **written consent** of the patient as required by Federal law.

Please Note: Parents must have the written consent of their student for the release of any protected health information (PHI). Guarantor of payment is not considered written consent for access to PHI.

Medical Insurance

NC State University requires all undergraduate degree-seeking students who are taking 6 or more credit hours to either purchase the University-sponsored health insurance plan (Student Blue) or provide evidence of an existing creditable health insurance policy. Students who are already covered by an insurance policy (i.e. through parent plans, family plans, employer-sponsored plans, or student health insurance) and wish to waive out of the university-sponsored plan must submit a waiver for each term.

Students enrolled in Distance Education courses only are not eligible for health insurance and therefore are not required to submit a waiver.

Students who do not waive out by the waiver deadline will automatically be enrolled in and billed each semester for the university-sponsored health insurance plan. This university-sponsored health insurance plan has a robust set of benefits at an affordable premium. More information regarding the health insurance requirement and/or the university-sponsored health insurance plan is available on the Student Health Services website (https://healthypack.dasa.ncsu.edu/).

Student Health Center
2815 Cates Ave
Campus Box 7304
Raleigh, NC 27695-7304
919.515.2563
healthypack@ncsu.edu

Julie Casani, M.D., MPH - Director and Medical Director

Student Legal Services

University Student Legal Services (USLS) was created by Student Government to provide high quality legal services to currently enrolled NC State students. It is a 501(c)(3) nonprofit corporation funded by student fees, which provides affordability for the students. The purpose of the service is to provide legal education, advice, and representation within the scope of the prepaid student legal services plan that is registered with the North Carolina State Bar. The office promotes preventative law, enabling the students to make educated choices that will hopefully resolve their legal issues with as little disruption to their well-being and academic goals as possible. USLS provides advice, limited court representation, document creation and review as wells as educational seminars and materials on legal issues affecting students. The usual areas of law that most impact students are landlord tenant, consumer matters, employment questions, immigration, traffic and DMV issues, criminal issues as well as domestic matters.

Confidentiality

The staff are not employees of NC State or the State of North Carolina and as licensed attorneys are required to preserve the confidentiality of clients. All staff working with the office are bound by the Rules of Professional Conduct relating to nondisclosure of any information that has been discussed. The policy is firmly followed by the office to encourage clients to speak candidly about all information necessary for effective legal representation.

To learn more about Student Legal Services and the services that we can provide, visit our website (https://studentlegal.dasa.ncsu.edu/).

1107 Pullen Hall
210 Dan Allen Dr.
Campus Box 7123
Raleigh, NC 27695-7123
919.515.7091
studentlegal@ncsu.edu

Pamarah Gerace, Director and Staff Attorney

Student Services Center

The Student Services Center (SSC) is NC State's one-stop center for student registration, financial aid, and billing needs. The Center was formed in 2016 to merge the resources and services of the University Cashier's Office, Department of Registration and Records, and Office of Scholarships and Financial Aid in order to better serve the students of NC State. Students can visit the SSC in Harris Hall on Main Campus to order an official transcript, receive an enrollment verification, meet with a financial aid counselor, or discuss payment options with the university cashiers.

The Student Services Center website provides helpful information for students on how to search and register for classes, as well as everything they need to know about staying on track to graduate. Our experts are ready to help incoming, current and former members of the Wolfpack--and their families--accomplish any financial or academic task necessary.

Department of Registration and Records

The Department of Registration and Records is responsible for maintaining student records and enrollment systems, establishing the academic calendar, establishing and upholding policies on academic standards, and providing several other essential services to students and faculty on campus.

Charles Clift, University Registrar

Office of Scholarships and Financial Aid

The Office of Scholarships and Financial Aid is responsible for evaluating students' financial need and eligibility, awarding financial aid packages, disbursing federal and state financial aid awards, and upholding policies on academic standards for financial aid recipients.

Financial aid counselors and staff at NC State are trained and highly equipped to meet the needs of all students, even those with the most exceptional of circumstances. We are dedicated to working with students as closely as possible to ensure a seamless transition to NC State without financial worry.

Krista Ringler, Associate Vice Provost and Director

University Cashier's Office

The University Cashier's Office projects a positive image of the University by providing courteous and professional service. We treat each individual customer with dignity and respect. Financial services for the University are provided in an ethical and professional manner with a focus on fiscal integrity and accountability. The success of our students will always be our primary concern.

Maria Brown, Director

Learn more about the Student Services Center on our website (https://studentservices.ncsu.edu/).

*The Student Services Center is bound by the **Family Educational Rights and Privacy Act (FERPA)**, which gives students certain rights to privacy of their education records and rights of access to their education records. Employees and agents of the University are expected to comply fully with this law. Please review the NC State* REG 11.00.01 - Family Educational Rights and Privacy Act (FERPA) *(*https://policies.ncsu.edu/regulation/reg-11-00-01*) for detailed information about this federal law and what it means for our students, their families, and sharing of student information.*

2000A Harris Hall
2183 Thurman Dr
Raleigh, NC 27695
919.515.6278
studentservices@ncsu.edu

The NC State Libraries

The NC State Libraries' website (http://www.lib.ncsu.edu) is a rich source of information and serves as a gateway to resources and services.

The D.H. Hill Jr. Library is open 24 hours/day in the fall and spring semesters. Branch libraries include: Harrye B. Lyons Design Library, Natural Resources Library, and William Rand Kenan, Jr. Library of Veterinary Medicine.

The Libraries' collections reflect the strengths of the university across disciplines. We provide demand-driven, network-based collections to the campus community in support of research and teaching. We are recognized as a national leader in building extensive research holdings in the areas of engineering, science, technology, and agriculture. The collection contains over 5.3 million volumes of books, bound journals, and government documents; over 128,000 print and electronic serial subscriptions; over 1.2 million e-books; 635 full-text databases in all disciplines and extensive digital collections; numerous video, audio, and multimedia titles; unique and rare materials in the Special Collections Research Center. The Libraries' participation in the Triangle Research Libraries Network (TRLN) provides convenient access to the collections of Duke University, UNC-Chapel Hill, and NC Central University.

Key spaces at the libraries include:

- Learning Commons, Faculty Research Commons, Graduate Student Commons
- Large-scale, immersive visualization spaces
- Digital media creation facilities
- Dataspace with advanced computing, software, training, and consultation (Hunt)
- A Game Lab for the scholarly study and enjoyment of games and for interactive workshops and demonstrations
- iPearl Immersion Theater for panoramic display of faculty and student work (Hunt)
- Makerspaces offering 3D printing and scanning and other specialized tools
- Special Collections Reading Room and Exhibit Gallery (Hill)

The James B. Hunt Jr. Library (https://www.lib.ncsu.edu/hunt-library/) on Centennial Campus is more than the 21st-century face of NC State. It's a place where ideas become reality and bold ambition forges beautiful solutions to global challenges.

The Libraries website (http://www.lib.ncsu.edu) provides information about and access to many services, including reference assistance, interlibrary loan, and electronic reserves. Library Course Tools (http://www.lib.ncsu.edu/course/) web pages are available for every course offered at NC State. These customized pages include e-reserves, article databases, librarian recommendations, citation tools, IM a Librarian for help, and more. The Libraries' Course Books on Reserves program makes over 4,500 required texts available on Course Reserves each year.

Greg Raschke, Senior Vice Provost and Director of Libraries

Transportation

Parking Permits

All students living on or off-campus may purchase a parking permit based on completed credit hours and permit availability. First-year resident parking permits are sold via a permit lottery, while all other parking permits are sold on a first come first serve basis. Demand for permits exceeds supply, so parking permits do sell out. Students must be registered for classes to purchase a parking permit. All parking permits can be purchased online. All student parking permits are virtual. See our website for more information, transportation.ncsu.edu.

Wolfline

Wolfline is NC State's own full-service transit system. Wolfline operates everyday class is in session, with limited service on weekends and breaks. Routes connect all three campuses, multiple park-and-ride lots, official NC State housing, and other destinations adjacent to campus. Buses are open to the general public and do not require any ID, pass, or fare. All buses are branded in NC State Wolfpack red, white, and black. Buses only stop at designated stop locations.

Please visit the Wolfline website (https://transportation.ncsu.edu/wolfline/) for the most up-to-date information about park-and-ride locations, bus routes, and schedules.

Alternative Transportation Options

NC State University Transportation offers the following alternative transportation options:

- **Bicycling:** Bicycling is an inexpensive, healthy, and environmentally-friendly way to travel to, from, and around campus. Bike racks are conveniently located throughout our three campuses, as well as on all Wolfline buses. Bicycle lockers (https://transportation.ncsu.edu/bike-locker-rental-form/) are available to rent and two bicycle fix-it stations are available on campus for basic bike repairs and adjustments. Students are strongly encouraged to register their bicycles (https://transportation.ncsu.edu/bicycling/) through the Transportation office. Campus Police also offer free engraving on bicycles.
- **Carpool**: NC State students who participate in the student carpool program (https://transportation.ncsu.edu/student-commuter-benefits/) can enjoy carpooling benefits and gain access to premium parking areas. The Transportation office requires at least two commuter students to form a carpool. All registered carpool participants must show proof of vehicle registration and a local address.
- **Local/Regional Transit**: GoRaleigh (https://goraleigh.org/), the City of Raleigh's public transit system, offers a city-wide bus service. Four GoRaleigh routes serve the NC State campus: Routes 4, 11, 11L, and 12. GoTriangle (https://gotriangle.org/) provides regional bus service to NC State from Raleigh, Cary, Apex, Durham, Chapel Hill, Wake Forest, Zebulon, Wendell, and many points in between, including the RDU airport. Currently, GoRaleigh and GoTriangle buses are not collecting fares through June 30, 2022, so the buses are free to ride without a pass.
- **Micro mobility**: NC State's scooter-share partnership provides scooters for use by students, employees, and visitors. Find details on our website (https://transportation.ncsu.edu/lime-scooter-share/).
- **Walking**: As an urban campus, NC State University is very walkable with short distances to off-campus locations such as shopping and restaurants, as well as between campus destinations. Many students and staff choose to walk to school or work, and/or combine walking with another alternative mode to get around campus. Visit the Transportation website (https://transportation.ncsu.edu/walking/) to download a Walk Times map.
- **Wolfpack Pick Up**: Wolfpack Pick Up is a service designed for students with injuries or living with disabilities. Wolfpack Pick Up services students on both Main Campus and Centennial campus. Rides are scheduled online (https://wolfpackpickup.dasa.ncsu.edu/). Questions about scheduling may be directed to wolfpackpickup@ncsu.edu.

NC State Transportation
Administrative Services I, 2721 Sullivan Drive
Campus Box 7221
Raleigh, NC 27695
Customer service hours: Monday-Friday, 7:00 a.m. - 5:00 p.m.
Office hours: Monday-Friday, 7:30 a.m. - 5:00 p.m.

TRIO Programs

TRIO Programs are Federal outreach and student services programs designed to serve and assist low-income individuals, first-generation college students, and individuals with disabilities to progress through the academic pipeline from middle school to post-baccalaureate degrees. Of these eight programs, NC State University hosts four programs, including the two premier TRIO pre-college programs, Educational Talent Search (1991) and Upward Bound (1978 and 2012). Collectively they have served thousands of students providing access to higher education. The Student Support Service program for undergraduate students launched in 2010. The Student Support Services STEM program launched in 2015. The Ronald E. McNair Postbaccalaureate Achievement Program launched in 2017.

TRIO Collegiate Programs (Student Support Services, Student Support Services STEM & Ronald E. McNair Scholars Programs)
Park Shops 204
NC State Box 7105
Raleigh, NC 27695-7105

Courtney Simpson, Senior Director, TRIO Collegiate Programs

TRIO Pre-College Programs (Talent Search & Upward Bound Programs)
407 Gorman St
NC State Box 7319
Raleigh, NC 27695-7319
Website (http://trio.dasa.ncsu.edu)

Maurice Mathis, Senior Director, TRIO Pre-College Programs

Undergraduate Research (OUR)

The office of Undergraduate Research supports and promotes undergraduate opportunities in discovery, inquiry, and creativity-based scholarship through mentored research experiences with NC State faculty and other national and international scholars and professionals. Undergraduate Research is scholarly study in any discipline in which this scholarship culminates in advancements in science, technology, engineering, business, the arts, or humanities. Students from any discipline can engage in the excitement of scholarly research and present their work at multiple annual symposia. Research and travel awards supporting both student projects and the communication of results are available.

Contact

2229 Broughton Hall
NC State Box 7576
Raleigh, NC 27695-7576
Phone: 919.513.0095
Fax: 919.513.7542
Website (http://undergradresearch.dasa.ncsu.edu)

Dr. Catherine Showalter, Associate Director

University Fellowships Office (UFO)

The **University Fellowships Office (UFO)**--formerly called the Fellowship Advising Office--helps NC State's undergraduate students, graduate students, and alums learn of and apply for nationally competitive and prestigious awards. These awards fund a wide range of opportunities, and many are connected to undergraduate and graduate degree programs or internships, overseas opportunities, and independent projects.

Some of our services include:

- Meeting with candidates to discuss their goals and interests and to help identify matching opportunities
- Reviewing and critiquing drafts of application essays and statements
- Providing institutional endorsements for applicants who receive the campus nomination (for the awards that require nominations/ endorsements)
- Submitting application materials at the national level on behalf of applicants
- Staging practice interviews for applicants selected at the national level for finalist interviews

Contact

Clark Hall
221 Jensen Drive
NC State Box 8610
Raleigh, NC 27695-8610
919.515.2237
fellowship-advising@ncsu.edu
Website (https://fellowships.dasa.ncsu.edu/)

Courtney Hughes, Director

University Housing

Living on Campus

Living on campus is an essential part of the Wolfpack experience: that's why students are required to live in University Housing their first year.

When you live on campus, you'll be at the heart of the Wolfpack nation, making it easy to be a part of all that NC State has to offer. Whether you're looking for the close-knit community of a village (https://villages.dasa.ncsu.edu/) or the diverse social opportunity of a traditional residence hall, we have the housing option (https://housing.dasa.ncsu.edu/find-a-community/) that's right for you. With a selection of 20 residence halls (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/) and four on-campus apartment communities (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/), you'll enjoy the once-in-a-lifetime opportunity to live in the heart of NC State.

Get Started with University Housing

Incoming First-Year Students

1. **Apply for housing:** You should complete your University Housing and Living and Learning Village application as soon as possible.

Students who have received acceptance for the Fall semester may access the housing application through the Campus Living section on MyPack Portal (https://mypack.ncsu.edu/). If you decide not to attend NC State, you can cancel your housing application without penalties. Space is assigned in the order in which applications are received. If you have a preferred building or roommate already in mind, an early application will help you get them.

2. **Choose a place to live:** You have a lot of options to choose from, ranging from residence halls to our Wolf Village Apartments. Find the ones that you like best (https://housing.dasa.ncsu.edu/find-a-community/).

Incoming Transfer Students

Due to the first-year live-on requirement that began in 2017, space is very limited for upper-class students. There are options available, however. NC State has two Living and Learning Villages that reserve space for transfer students.

1. Located in Wolf Village Apartments (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/wolf-village-apartments/) on the main campus, the Second-year Transitions And Transfer Experience (S.T.A.T.E.) Village (https://villages.dasa.ncsu.edu/village-options/state-village/) connects students to a variety of campus resources and programming meant to navigate their years following their freshman experience.
2. Located in Wolf Ridge Apartments (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/wolf-ridge-apartments/) on Centennial Campus, Albright Entrepreneurs Village (https://villages.dasa.ncsu.edu/village-options/albright-entrepreneurs-village/) residents live and work with entrepreneurial-minded peers of all disciplines to explore and develop their ideas in an environment that inspires creativity and innovation (https://villages.dasa.ncsu.edu/village-options/albright-entrepreneurs-village/village-benefits/).

Undergraduate students must be enrolled in at least 12 credit hours to be eligible to live on campus during the fall and spring terms. Students who must drop below these minimum requirements should contact University Housing to request an exception. Summer session housing (https://housing.dasa.ncsu.edu/current-residents/summer-housing/) is also available.

More Information

For more information about living on campus, visit:

University Housing
Monday - Friday | 8:00 a.m. to 5:00 p.m.
1112 Pullen Hall
201 Dan Allen Drive
Raleigh, NC 27695-7315
919.515.2440
housing@ncsu.edu
Website (https://housing.dasa.ncsu.edu/)

Living and Learning Villages

NC State's **Living and Learning Villages** are interested-based living communities that engage students both inside and outside the classroom. Villages provide an unparalleled living experience where you'll make life-long friends and immerse yourself in the NC State community. There is currently no additional cost to join a village.

Albright Entrepreneurs Village (https://villages.dasa.ncsu.edu/village-options/albright-entrepreneurs-village/): live in Wolf Ridge Apartments (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/wolf-ridge-apartments/)
The Albright Entrepreneurs Village provides sophomores, juniors, seniors and graduate students across all academic disciplines the opportunity to live, socialize and work with entrepreneurial-minded students. Residents can explore and develop their entrepreneurial interests in an environment that fosters creativity.

Arts Village (https://villages.dasa.ncsu.edu/village-options/arts-village/): live in Turlington Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/turlington-hall/)
Creative, vibrant and colorful only begin to describe the experiences you'll have as you explore theater, visual arts, crafts, music, dance and more.

Black Male Initiative (https://villages.dasa.ncsu.edu/village-options/black-male-initiative/): live in Avent Ferry Complex (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/avent-ferry-complex/)
BMI strives to establish a brotherhood and develop leaders among black male students. By promoting academic success, personal growth, professional development, and self-responsibility, the group breaks through negative stereotypes and combats challenges facing African-American males in today's society.

EcoVillage (https://villages.dasa.ncsu.edu/village-options/ecovillage/): live in Bragaw Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/bragaw-hall/)
EcoVillage is a first-year student program that welcomes students from all majors, creating both a multi-disciplinary and an interdisciplinary educational experience that prepares students for lifelong sustainable leadership, engagement, advocacy, and discovery.

Engineering Village (https://villages.dasa.ncsu.edu/village-options/engineering-village/): live in Sullivan Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/sullivan-hall/)
The Engineering Village is an extension to the College of Engineering's First-Year Engineering (https://www.engr.ncsu.edu/academics/undergrad/firstyear/) program introducing students to the field of engineering; encouraging thoughtful consideration to complex challenges facing our communities.

Exploratory Studies Village (https://villages.dasa.ncsu.edu/village-options/exploratory-studies-village/): live in Tucker (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/tucker-hall/), Owen, (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/owen-hall/) or Bowen Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/bowen-hall/)
The Exploratory Studies Village is for students entering the university who are knowingly undecided about a major. A year of guided inquiry and exploration coupled with one-on-one sessions with their academic advisor helps move students through the career planning and decision-making process.

Global Village (https://villages.dasa.ncsu.edu/village-options/global-village/): live in Alexander Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/alexander-hall/)
Global Village is a living and learning community for those interested in living and interacting with people from differing backgrounds, experiences, countries, and viewpoints.

Honors and Scholars Village (https://villages.dasa.ncsu.edu/village-options/honors-and-scholars-village/): live in Berry, Becton or Bagwell Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/berry-hall/)
Honors Village and Scholars Village merged in 2017 to become Honors and Scholars Village (https://villages.dasa.ncsu.edu/village-options/honors-and-scholars-village/). The most noticeable change being that Scholars Village residents will be relocating from Sullivan Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/sullivan-hall/) to east campus beginning Fall 2018. Students from both the University Honors Program (https://honors.dasa.ncsu.edu/) (UHP) and the University Scholars Program (https://scholars.dasa.ncsu.edu/) (USP) will now live together in the Honors Commons. The move will provide village residents with the opportunity to live and learn in a vibrant, socially and intellectually stimulating environment that fosters mindful interaction.

Impact Leadership Village (https://villages.dasa.ncsu.edu/village-options/impact-leadership-village/): live in Bowen Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/bowen-hall/)
ILV provides experiential learning for students who have a passion for leadership and service. Students are given the opportunity to engage in practical application of leadership to real-world issues and explore leadership development through one on one sessions with professionals. ILV enhances students' college experience and prepares leaders to make their personal IMPACT on the state, nation, and the world.

Native Space (https://villages.dasa.ncsu.edu/village-options/native-space/): live in Wood Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/wood-hall/)
Students living in the Native Space community will demonstrate growth and learning along three focal points of the living experience: culture, academics and community engagement. Residents will find a deeper awareness of Native American history and drive cultural awareness through participation in Native American Heritage Month and the annual NC State Pow Wow.

Students Advocating for Youth (https://villages.dasa.ncsu.edu/village-options/students-advocating-for-youth-village/): live in Syme Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/syme-hall/)
SAY Village is a community for first-year students in any academic discipline who have a passion for working with youth. Students develop one-on-one mentoring relationships with local elementary school students and learn what it means to be a youth advocate.

S.T.A.T.E. Village (https://villages.dasa.ncsu.edu/village-options/state-village/): live in Wolf Village Apartments (https://housing.dasa.ncsu.edu/find-a-community/apartment-options/wolf-village-apartments/)
Provides second-year and transfer students with opportunities to make the most of their NC State experience by focusing on the six core pillars essential to student success: academic success, career development, community and global engagement, diversity, leadership, and life skills.

Wellness Village (https://villages.dasa.ncsu.edu/village-options/wellness-village/): live in Wood Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/wood-hall/)
Encourages and promotes the development and maintenance of a healthy body, mind, and spirit through a wide array of wellness programs and events. Students have the opportunity to experience personal growth while learning about the seven dimensions of wellness.

Women in Science and Engineering (https://villages.dasa.ncsu.edu/village-options/women-in-science-and-engineering-village/): live in Lee Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/lee-hall/)
WISE Village was created for female freshman and sophomore students majoring in science, technology, engineering, and mathematics. Membership in WISE provides a powerful networking opportunity with other goal-oriented women as you pursue your STEM major.

Women Of Welch Village (https://villages.dasa.ncsu.edu/village-options/women-of-welch-village/): live in Welch Hall (https://housing.dasa.ncsu.edu/find-a-community/residence-hall-options/welch-hall/)
WOW Village enhances women's leadership outside the classroom through empowerment, leadership development, self-awareness and diversity/social justice. WOW creates a holistic community that fosters individual women's growth and development while challenging residents to act as citizens of a global community.

Wellness and Recreation

About Wellness and Recreation

The Department of Wellness and Recreation is proud to be a leader of wellness at NC State. We value the impact of movement and inspire behaviors that improve health and well-being. Our programs, services and facilities enhance academic success by assisting students in developing skills and resilience needed for college and beyond.

Programs and Services

Take one of the more than 100 Group Fitness (https://wellrec.dasa.ncsu.edu/fitness/group-fitness-2/) classes offered each week, designed for every fitness level. Challenge yourself by taking cycling, TRX®, yoga, BODYPUMP™, Zumba® or various other class formats and experience firsthand how we make fitness fun. Students can take their structured workout to the next level with Small Group Training (https://wellrec.dasa.ncsu.edu/fitness/training-services/small-group-training/), where our coaches lead workshops on Olympic lifting, boxing and more.

Receive one-on-one attention from our nationally-certified personal trainers (https://wellrec.dasa.ncsu.edu/fitness/training-services/personal-training/). Learn how to exercise, improve performance and establish fitness goals. No matter what your fitness level, we have a trainer who wants to work with you.

Our ThriveWell (https://wellrec.dasa.ncsu.edu/wellness-2/) program offers wellness coaching and health education programs for individuals and groups. Wellness coaching takes a holistic approach and discovers how personal wellness impacts student success, strengths, values and goals. Establish a wellness plan and stay accountable with a certified health coach. Learn stress management techniques, strategies and lifestyle modification tips from our team of experts.

Intramural Sports (https://wellrec.dasa.ncsu.edu/sports/intramural-sports/) offers more than 40 different leagues and events throughout the year. Sports range from flag football, basketball, soccer and volleyball to exciting and unique events such as pool battleship, bubble soccer and cricket. Create a team, compete for a championship, join a recreational

league with friends or sign up for an individual/dual sport or special event to find a new favorite activity.

For students seeking a more competitive sports experience, check out one of the Club Sports (https://wellrec.dasa.ncsu.edu/sports/club-sports/) teams that include a wide variety of men's, women's and co-ed sports. These student-led organizations practice regularly and compete against other colleges and universities at local, state and national levels.

Outdoor Adventures (https://wellrec.dasa.ncsu.edu/outdoor-adventures/) offers students unique outdoor trips and educational clinics. Rent outdoor equipment from the Outdoor Adventures Equipment Rental Center or climb to new heights on the indoor climbing wall and bouldering cave. Students can challenge themselves individually or build a community with customized programs at our Challenge Course (https://wellrec.dasa.ncsu.edu/outdoor-adventures/challenge-course/) located in Schenck Memorial Forest.

Our Student Employment (https://wellrec.dasa.ncsu.edu/about-us-2/student-employment/) program supports more than 700 students employed annually through Wellness and Recreation. Students enhance their development by learning transferable skills that will prepare them for future careers.

Wellness and Recreation Center and Carmichael Gym

The Wellness and Recreation Center and Carmichael Gym (https://wellrec.dasa.ncsu.edu/facilities/rec-sports-master-plan/carmichael-addition/) is a 400,000-square-foot facility designed to help students achieve their personal wellness, recreation and fitness goals.

Features include:

- Strength and Conditioning Centers (50,000-square-foot)
- Six Fitness/Activity rooms
- Dedicated Mind-Body studio
- Teaching kitchen
- 11 Indoor Basketball/Multipurpose courts
- 25-yard pool and dive well
- 50-meter pool
- Indoor climbing wall and bouldering cave
- Indoor track
- 11 racquetball courts
- One squash court
- Personal training suite
- Men's and women's locker rooms
- Single occupant locker rooms
- Steam room
- Sauna
- Equipment Checkout
- Day-use lockers
- Social lounges

Wellness and Recreation manages numerous outdoor facilities that promote healthy, active living.

- Miller Outdoor Recreation Field
- Method Road Recreation Complex
- 12 outdoor tennis courts
- Four outdoor basketball courts
- FitGround outdoor functional training area
- Centennial Campus Recreation Fields
- Centennial Campus Disc Golf Course

Wolfpack One Card

The Wolfpack One Card is the official ID card for NC State students, faculty, staff and affiliates. The One Card allows NC State students to:

- Access meal plans
- Enter their residence hall or other buildings with restricted access
- Work out at the gym
- Check out books at the library
- Create and access their AllCampus account to make purchases at participating on-campus locations. All Campus funds are also used for Wolfprint (campus air printers). Wolfprint provides quick and easy printing at a variety of buildings across campus.

Incoming students receive their card during summer orientation. New graduate students will not receive ID cards during the New Graduate Student Orientation, and should visit the One Card office in Talley Student Union to obtain an ID card.

Students are encouraged to store their card in a safe and convenient location as they will use it often during the course of a day. Don't hole punch it or tumble it in a dryer to extend the life of the card. Replacement cards are $20.

To report a lost or stolen card, students should call or visit the Wolfpack One Card office or go online (http://onecard.ncsu.edu/). The office is located on the main level of Talley Student Union. Students can also stop by to ask questions about the many features of the ID card during regular business hours: Monday - Friday from 8 a.m. - 6 p.m.

For more information, call us at 919.515.3090 or visit the Wolfpack One Card website (https://onecard.ncsu.edu/).

Graduate

Graduate instruction was first offered at North Carolina State University in 1893, and the first doctoral degree was conferred in 1926. In the ensuing years, the Graduate School has grown steadily and now provides instruction and facilities for advanced study and research in the fields of agriculture and life sciences, design, education, engineering, natural resources, humanities and social sciences, management, physical and mathematical sciences, textiles and veterinary medicine.

The Graduate School is currently composed of more than 2,400 graduate faculty members. Educated at major universities throughout the world and established both in advanced teaching and research, these scholars guide the University's more than 7,000 master's and doctoral students from all areas of the U.S. and many other countries. The faculty and students have available exceptional facilities, including libraries, laboratories, modern equipment and special research areas.

Additionally, a cooperative agreement exists among the Graduate Schools of the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro, Duke University, and North Carolina State University which increases the educational and research possibilities associated with each institution.

The Graduate Catalog contains Graduate School requirements and pertinent information for individual graduate programs, a current list of graduate faculty, and a selection of other resources for new students. The Catalog is informational only and is subject to change. Official policies and procedures are in the Graduate Handbook (p. 924) and on the NC State Policies, Rules, and Regulations (https://policies.ncsu.edu/) web site.

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College of Agriculture and Life Sciences

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Agricultural and Extension Education

Our graduate programs offer flexibility and enable graduates to pursue diverse career options. Prepare for a career teaching agricultural education to middle or high school students, or become an Extension agent helping farmers and families succeed in their communities. Pursue other rewarding positions such as agricultural museum curators, environmental educators, agricultural missionaries, agricultural public relations representatives, or congressional officers.

The following graduate programs in Agricultural and Extension Education are available:

- Graduate Certificate in Agricultural and Extension Education (requires 15 hours)
- Master of Science in Agricultural and Extension Education (requires 36 hours including a thesis)
- Master of Agricultural and Extension Education (requires 30 hours; can be taken as an on-campus degree or a 100% internet-based degree program)
- Sixth-Year Certificate in Agricultural Education
- Doctor of Education in Agricultural and Extension Education (requires 72 hours)

Admission Requirements

- A minimum undergraduate GPA of 3.0 for Masters and Certificate applicants; a minimum graduate GPA of 3.5 for Doctoral applicants
- Three letters of recommendation
- A statement of purpose: Prospective graduate students will draft a statement of purpose for graduate work. If the student intends to complete a thesis or dissertation, the statement should also indicate the nature of potential research work, including possible topics or questions, and minimally two professors from the Agricultural and Human Science department whose research areas potentially align with those possible research topics. Prospective students should plan to meet with faculty prior to submitting their applications to discuss

the research with those professors and include those ideas in the statement.

- Relevant experience – for doctoral applicants
  - 1 year required experience, 3 years recommended
    - Relevant experience in extension, teaching, industry, leadership, or other closely related field

Master's Degree Requirements

The Department offers an M.S. degree, which requires a thesis for which the student receives six hours of credit, and a Master of Agricultural and Extension Education (M.R.) as a non-thesis track. The M.S. degree requires a total of 36 credit hours, whereas the M.R. degree requires 30 credit hours. The student's advisory committee will meet with the student to determine the appropriate courses for their Plan of Work. M.S. students have the option of adding a minor which requires a minimum of 9 credit hours.

Graduate Certificate Requirements

The Department also offers a graduate certificate in agricultural and extension education. This certificate program involves completion of 15 credit hours divided into two focuses: Agricultural Education and Extension Education.

Sixth-Year Certificate

The Department offers an array of courses that are recognized by the NC Department of Public Instruction as comprising a Sixth-Year Certificate. Students are required to complete 24 hours of advanced graduate work past the Master's degree. Contact the Director of Graduate Programs for details.

Doctoral Degree Requirements

A Doctor of Education (Ed.D.) degree in Agricultural and Extension Education is offered. A minimum of 72 hours past the Bachelor's degree is required. More hours may be required based upon the past degrees and experiences of the candidate. The student's graduate committee will determine the specific courses needed. At least six hours of statistics is required. Twelve hours of credit is earned for writing the dissertation (AEE 895). The student's advisory committee will meet with the student to determine the appropriate courses for their Plan of Work.

Student Financial Support

A limited number of research and/or teaching assistantships are available on a competitive basis. Applications for open positions are due in January for the following academic year. Other financial aid is available from the Office of Financial Aid and on a competitive basis from the Graduate School.

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Faculty

Full Professors

Koralalage Sunil Upali Jayaratne

Barbara Kirby

Associate Professors

Jackie Bruce

Travis Dale Park

Wendy J. Warner

Assistant Professors

Joseph L. Donaldson

Misty D. Lambert

Katherine McKee

Joy Morgan

Agricultural and Extension Education (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 578	Scientific Inquiry in Agricultural and Extension Education		
Curriculum/Program Planning			
AEE 521	Program Planning in Agricultural and Extension Education		
or AEE 524	Coordinating the High School Agricultural Education Program		
or AEE 529	Curriculum Development in Agricultural and Extension Education		
Instructional Methodology			
AEE 523	Adult Education in Agriculture		
or AEE 535	Teaching Agriculture in Secondary Schools		

or AEE 735	Effective Teaching in Agriculture and Life Sciences	
Culminating Master's Project		
AEE 620	Special Problems in Agricultural and Extension Education	
or AEE 693	Master's Supervised Research	
Elective Courses		**15**
Elective Courses are determined in conjunction with the academic committee		
Total Hours		**30**

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Agricultural and Extension Education (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 578	Scientific Inquiry in Agricultural and Extension Education		
AEE 735	Effective Teaching in Agriculture and Life Sciences (recommended for those who desire to teach in higher education)		
Additional Course in Research or Statistics		**3**	
ST 507	Statistics For the Behavioral Sciences I		
or ST 511	Statistical Methods For Researchers I		
Research		**3**	
AEE 777	Qualitative Research Methods in the Agricultural & Life Sciences		
or ST 507	Statistics For the Behavioral Sciences I		
or ST 511	Statistical Methods For Researchers I		
Curriculum/Program Planning		**3**	
AEE 521	Program Planning in Agricultural and Extension Education		
or AEE 524	Coordinating the High School Agricultural Education Program		
or AEE 529	Curriculum Development in Agricultural and Extension Education		
Instructional Methodology		**3**	
AEE 523	Adult Education in Agriculture		
or AEE 535	Teaching Agriculture in Secondary Schools		
Elective Courses [1]		**9**	
Elective Courses are determined in conjunction with the academic committee to meet the 36 total hours			
Thesis Course		**6**	
AEE 695	Master's Thesis Research		
Total Hours		**36**	

[1] These can be in AEE or in disciplines such as Animal Science, Crop Science, Horticulture, Entomology, Forestry, and Youth Development and Family Life Education, among others. Although it is not required, students can also declare a minor. Students will need to take 9-12 hours in a specialty and work with a professor from that area.

Faculty

Full Professors

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Barbara Kirby

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Joseph L. Donaldson

Misty D. Lambert

Katherine McKee

Joy Morgan

Agricultural and Extension Education (EdD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 578	Scientific Inquiry in Agricultural and Extension Education		
Statistics Course Sequence		**6**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
Research Breadth Courses		**6**	
Select at least two courses below:			
AEE 777	Qualitative Research Methods in the Agricultural & Life Sciences		
ED 710	Applied Quantitative Methods in Education I		
ED 730	Introduction to Qualitative Research in Education		
ED 731	Advanced Qualitative Research and Data Analysis in Education		
Elective Courses		**42**	
Elective Courses are determined in conjunction with the academic committee to meet the 72 total hours			
Dissertation Research		**12**	
AEE 895	Doctoral Dissertation Research [1]		
Total Hours		**72**	

[1] Students will repeat course to meet 12 credit hours

Faculty

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Travis Dale Park

Wendy J. Warner

Assistant Professors

Joseph L. Donaldson

Misty D. Lambert

Katherine McKee

Joy Morgan

Agricultural & Extension Education (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
AEE 500	Agricultural Education, Schools and Society	3	
AEE 501	Foundations Of Agricultural and Extension Education	3	
AEE 503	Youth Program Management	3	
AEE 505	Trends and Issues in Agricultural and Extension Education	3	
AEE 521	Program Planning in Agricultural and Extension Education	3	
AEE 522	Occupational Experience in Agriculture	3	
AEE 523	Adult Education in Agriculture	3	
AEE 524	Coordinating the High School Agricultural Education Program	3	
AEE 526	Information Technologies in Agricultural and Extension Education	3	
AEE 535	Teaching Agriculture in Secondary Schools	3	
AEE 545	Methods of Change in Agricultural and Human Sciences	3	
AEE 550	Leadership Theory	3	
AEE 560	Organizational Behavior and Administrative Leadership in Agricultural & Human Science	3	
AEE 565	Community Leadership	3	
AEE 577	Evaluation in Agricultural and Extension Education	3	
AEE 578	Scientific Inquiry in Agricultural and Extension Education	3	
AEE 595	Special Topics in Agricultural and Extension Education	1-6	
AEE 620	Special Problems in Agricultural and Extension Education	1-6	
AEE 641	Practicum In Agricultural and Extension Education	1-6	
AEE 705	International Agricultural Development	3	
AEE 735	Effective Teaching in Agriculture and Life Sciences	3	
AEE 777	Qualitative Research Methods in the Agricultural & Life Sciences	3	

Faculty

Full Professors

Koralalage Sunil Upali Jayaratne

Barbara Kirby

Associate Professors

Jackie Bruce

Travis Dale Park

Wendy J. Warner

Assistant Professors

Joseph L. Donaldson

Misty D. Lambert

Katherine McKee

Joy Morgan

Agricultural and Extension Education (Certificate)

The Department of Agricultural and Extension Education offers a Graduate Certificate in Agricultural and Extension Education. The program focuses on developing knowledge and skills needed to be effective teachers of agriculture in the public schools and community colleges or to work as an educator with the Cooperative Extension Service or in other non-formal educational settings such as public gardens, nature centers and in international development.

Admissions

Students apply online by visiting the Graduate School's website and completing an online application. Students currently in a graduate degree program should contact the program director for information regarding adding the certificate program to an existing degree program.

Requirements

The certificate program involves completion of 15 credit hours and the preparation of a professional portfolio. The career goals of the student will determine which sequence of courses to take.

Plan Requirements

The Graduate Certificate in Agricultural and Extension Education is divided into two focuses: Agricultural Education and Extension Education.

Certificates earned will be distributed as: "Graduate Certificate in Agricultural Education and Extension Education" without focus area specifications.

Code	Title	Hours	Counts towards
Select a Focus Area below, and select at least 5 courses within the corresponding list:		**15**	
Agricultural Education focus			
AEE 500	Agricultural Education, Schools and Society		
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 503	Youth Program Management		
AEE 522	Occupational Experience in Agriculture		
AEE 524	Coordinating the High School Agricultural Education Program		
AEE 529	Curriculum Development in Agricultural and Extension Education		
AEE 535	Teaching Agriculture in Secondary Schools		
AEE 641	Practicum In Agricultural and Extension Education		
AEE 735	Effective Teaching in Agriculture and Life Sciences		
Extension Education focus			
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 521	Program Planning in Agricultural and Extension Education		
AEE 523	Adult Education in Agriculture		
AEE 533	Leadership and Management of Volunteers in Agricultural and Extension Education		

AEE 560	Organizational Behavior and Administrative Leadership in Agricultural & Human Science	
AEE 577	Evaluation in Agricultural and Extension Education	
AEE 705	International Agricultural Development	
AEE 641	Practicum In Agricultural and Extension Education	
Total Hours		**15**

Animal Science

Animal science offers an opportunity for training in a diversity of basic sciences and the integration of such knowledge into the framework of a living system. Students can major in animal science or co-major in animal science and one of the following disciplines: biochemistry, genomics, genetics, microbiology, nutrition, physiology or statistics. Students can also concentrate in management and production areas.

Admission Requirements

Factors considered for admission include: grade point average, scores on the GRE, undergraduate courses, experiences, statement of interest, and letters of recommendation. In addition, a member of the Animal Science Graduate Faculty must be willing to serve as the applicant's advisor for the M.S. program.

Master of Science

A minimum of 30 credit hours, including 18 hours of graduate level course work in the degree program, is required. Students also complete and defend a thesis based on their research. The minor is optional. If a student selects a minor, the advisory committee must include a member from the minor field.

Master of Animal Science

The non-thesis Master of Animal Science (MR) degree (Option B) requires a minimum of 36 credit hours, 19 credits of core courses and 17 credits of elective courses. The MR degree program is also offered through distance education.

Student Financial Support

A limited number of research and teaching assistantships are available for students in the M.S. degree program through the department and are awarded on a competitive basis. Students are also supported by research grant funds awarded to faculty members. The total support package includes health insurance, tuition, and a stipend. Students applying for assistantships should apply by January 31 for fall admission.

Other Relevant Information

To provide an opportunity for students to develop their teaching skills, graduate students in a program that includes a thesis are required to assist in the departmental teaching program regardless of source of financial support. All graduate students in the Department of Animal Science who are mentored by departmental graduate faculty members are required to teach a minimum of one semester during their M.S. program.

Degrees

- Animal Science (MR) (p. 82)
- Animal Science (MS) (p. 92)
- Animal Science (Minor) (p. 94)

Faculty

Glen William Almond

Joan Eisemann

Charlotte E. Farin

Vivek Fellner

William Lucas Flowers IV

Fikret Isik

Sung Woo Kim

Duane K. Larick

Hsiao-Ching Liu

Christian Maltecca

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Steven Paul Washburn

Michael David Whitacre

Lon Weidner Whitlow

Charles Michael Williams

Todd Aaron Armstrong

Raymond Dean Boyd

Max T. Coffey

Kent A Gray

Jeffrey Alan Hansen

Justin W. Holl

Elizabeth A. Koutsos

Douglas Wyatt Newcom

Theo A. van Kempen

Rasha Qudsieh

Animal Science (MR)

Master of Animal Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses [1]		**4**	
ANS 601	Animal Science Seminar		
ST 511	Statistical Methods For Researchers I		
Biochemistry, Education, Economics or Business Core Course		**3**	
Select one of the following courses:			
AEE 521	Program Planning in Agricultural and Extension Education		
AEE 523	Adult Education in Agriculture		
AEE 526	Information Technologies in Agricultural and Extension Education		
ANS/BCH 571	Regulation of Metabolism		
Animal Science Core Discipline Core		**9**	
Genetics Course			
ANS 540	Animal Genetic Improvement		
Nutrition Course			

Select one of the following:		
ANS 550	Applied Ruminant Nutrition	
ANS/BCH 571	Regulation of Metabolism	
NTR 500	Principles of Human Nutrition	
Physiology Course		
Select one of the following:		
ANS 530	Advanced Applied Animal Reproduction	
ANS 552	Comparative Reproductive Physiology and Biotechnology	
ANS Elective Course (p. 83)		**3**
Elective Course (p. 84) [2]		**17**
Total Hours		**36**

1 No more than two (2) credit hours of a seminar to be included in the 36 credit hour total

2 Electives must differ from required coursework; only 6 hours can come from 400-level courses

ANS Elective Courses

Code	Title	Hours	Counts towards
ANS Elective Course		**3**	
Select one course below			
ANS 530	Advanced Applied Animal Reproduction		
ANS 540	Animal Genetic Improvement		
ANS 550	Applied Ruminant Nutrition		
ANS 552	Comparative Reproductive Physiology and Biotechnology		
ANS 553	Physiology and Genetics of Growth and Development		
ANS 561	Equine Nutrition		
ANS 565	Advanced Canine and Feline Nutrition		
ANS/BCH 571	Regulation of Metabolism		
ANS 590	Topical Problems in Animal Science (Advanced Meat Science)		
ANS 590	Topical Problems in Animal Science (Applied Non-Ruminant Nutrition)		
ANS 590	Topical Problems in Animal Science (Animal Growth and Development)		
ANS 590	Topical Problems in Animal Science (Advanced Beef Production)		
ANS 590	Topical Problems in Animal Science (Introduction to R Programming)		
ANS 590	Topical Problems in Animal Science (Stress Physiology)		
ANS 590	Topical Problems in Animal Science (Evaluation and Use of Breeds of Livestock)		
ANS 701	Protein and Amino Acid Metabolism		
ANS 713	Quantitative Genetics and Breeding		
ANS 726	Advanced Topics In Quantitative Genetics and Breeding		
ANS 790	Advanced Special Topics in Animal Science (Reproductive Mammalian Physiology I)		
ANS 790	Advanced Special Topics in Animal Science (Reproductive Mammalian Physiology II)		
Total Hours			**3**

Elective Courses

Code	Title	Hours	Counts towards
Elective Courses		**17**	
Select at least 6 of the following courses			
Agriculture and Extension Education			
AEE 426	Methods of Teaching Agriculture	3	
AEE 478	Advanced Issues in Extension Education	3	
AEE 503	Youth Program Management	3	
AEE 500	Agricultural Education, Schools and Society	3	
AEE 501	Foundations Of Agricultural and Extension Education	3	
AEE 505	Trends and Issues in Agricultural and Extension Education	3	
AEE 507	Comparative Agricultural and Extension Education	3	
AEE 521	Program Planning in Agricultural and Extension Education	3	
AEE 522	Occupational Experience in Agriculture	3	
AEE 523	Adult Education in Agriculture	3	
AEE 524	Coordinating the High School Agricultural Education Program	3	
AEE 526	Information Technologies in Agricultural and Extension Education	3	
AEE 529	Curriculum Development in Agricultural and Extension Education	3	
AEE 533	Leadership and Management of Volunteers in Agricultural and Extension Education	3	
AEE 535	Teaching Agriculture in Secondary Schools	3	
AEE 545	Methods of Change in Agricultural and Human Sciences	3	
AEE 550	Leadership Theory	3	
AEE 560	Organizational Behavior and Administrative Leadership in Agricultural & Human Science	3	
AEE 565	Community Leadership	3	
AEE 577	Evaluation in Agricultural and Extension Education	3	
AEE 578	Scientific Inquiry in Agricultural and Extension Education	3	
AEE 579	Research Design in Agricultural and Extension Education	3	
AEE 595	Special Topics in Agricultural and Extension Education	1-6	
AEE 735	Effective Teaching in Agriculture and Life Sciences	3	
AEE 705	International Agricultural Development	3	
Animal Science			
ANS 530	Advanced Applied Animal Reproduction	3	
ANS 531	Advanced Applied Animal Reproduction Lab	1	
ANS 540	Animal Genetic Improvement	3	
ANS 550	Applied Ruminant Nutrition	3	

ANS 552	Comparative Reproductive Physiology and Biotechnology	3
ANS 553	Physiology and Genetics of Growth and Development	3
ANS 554	Lactation, Milk and Nutrition	3
ANS 561	Equine Nutrition	3
ANS 565	Advanced Canine and Feline Nutrition	3
ANS 571	Regulation of Metabolism	3
ANS 575	Current Topics in Genomics and Proteomics in Animal Science	3
ANS 590	Topical Problems in Animal Science	1-3
ANS 601	Animal Science Seminar	1
ANS 603	Reproductive Physiology Seminar	1
ANS 604	Animal Breeding and Genetics Seminar	1
ANS 610	Topical Problems in Animal Science	1-6
ANS 641	Practicum in Animal Science	1-3
ANS 685	Master's Supervised Teaching	1-3
ANS 690	Master's Exam	1-9
ANS 693	Master's Supervised Research	1-9
ANS 695	Master's Thesis Research	1-9
ANS 696	Summer Thesis Research	1
ANS 699	Master's Thesis Preparation	1-9
ANS 701	Protein and Amino Acid Metabolism	3
ANS 702	Reproductive Physiology of Mammals	3
ANS 708	Genetics of Animal Improvement	3
ANS 709	Energy Metabolism	3
ANS 713	Quantitative Genetics and Breeding	3
ANS 726	Advanced Topics In Quantitative Genetics and Breeding	3
ANS 780	Mammalian Endocrinology	3
Agricultural Resource Economics		
ARE 404	Advanced Agribusiness Management	3
ARE 412	Advanced Agribusiness Marketing	3
ARE 413	Applied Agribusiness Marketing	3
ARE 433	U.S. Agricultural Policy	3
Biology		
BIO 405	Functional Histology	3
BIO 424	Endocrinology	3
BIO 434	Hormones and Behavior	3
BIO 444	The Biology of Love and Sex	3
BIO 488	Neurobiology	3
Biological and Agricultural Engineering		
BAE 435	Precision Agriculture Technology	3
BAE 472	Irrigation and Drainage	3
BAE 501	Sensors and Controls	3
BAE 535	Precision Agriculture Technology	3
BAE 535	Precision Agriculture Technology	3
BAE 572	Irrigation and Drainage	3
BAE 573	Introduction to Hydrologic and Water Quality Modeling	3
BAE 576	Watershed Monitoring and Assessment	3

BAE 578	Agricultural Waste Management	3
BAE 771	Theory Of Drainage--Saturated Flow	3
BAE 785	Food Rheology	3
Business Administration		
MBA 515	Enterprise Resource Planning Systems	3
MBA 520	Financial Management of Corporations	2
MBA 570	Opportunity Evaluation and Value Creation	3
MBA 576	Technology Entrepreneurship and Commercialization I	3
MBA 577	Technology Entrepreneurship and Commercializatior II	3
MBA 580	Creating Value in Organizations	3
MBA 585	Current Topics in BioSciences Management	3
MBA 586	Legal, Regulatory and Ethical Issues in Life Science Industries	3
Business Management		
BUS 590	Special Topics In Business Management	1-6
Molecular and Structural Biochemistry		
BCH 451	Principles of Biochemistry	4
BCH 452	Introductory Biochemistry Laboratory	2
BCH 453	Biochemistry of Gene Expression	3
BCH 454	Advanced Biochemistry Laboratory	4
BCH 455	Proteins and Molecular Mechanisms	3
BCH 552	Experimental Biochemistry	3
BCH 553	Biochemistry of Gene Expression	3
BCH 555	Proteins and Molecular Mechanisms	3
BCH 571	Regulation of Metabolism	3
BCH 703	Macromolecular Synthesis and Regulation	3
BCH 705	Molecular Biology Of the Cell	3
BCH 751	Biophysical Chemistry	3
BCH 761	Advanced Molecular Biology Of the Cell	3
BCH 763	Biochemistry Of Hormone Action	3
BCH 768	Nucleic Acids: Structure and Function	3
Biotechnology		
BIT 410	Manipulation of Recombinant DNA	4
BIT 462	Gene Expression Analysis: Microarrays	2
BIT 465	Real-time PCR Techniques	2
BIT 466	Animal Cell Culture Techniques	2
BIT 467	PCR and DNA Fingerprinting	2
BIT 468	Genome Mapping	2
BIT 501	Ethical Issues in Biotechnology	1
BIT 510	Core Technologies in Molecular and Cellular Biology	4
BIT 562	Gene Expression Analysis: Microarrays	2
BIT 564	Protein Purification	2
BIT 565	Real-time PCR Techniques	2
BIT 566	Animal Cell Culture Techniques	2

BIT 568	Genome Mapping	2
BIT 569	RNA Purification and Analysis	2
Comparative Biomedical Sciences		
CBS 662	Professional Conduct in Biomedical Research	1
CBS 754	Epidemiology II	3
CBS 760	Molecular Technologies for Epidemiologic Investigation	3
CBS 762	Principles of Pharmacology	3
CBS 770	Cell Biology	3
CBS 771	Cancer Biology	4
CBS 773	Advanced Developmental Biology	2
CBS 774	Epidemiology Of Infectious Diseases Of International Importance	3
CBS 780	Veterinary Production Epidemiology	2
CBS 783	Advanced Immunology	3
CBS 785	Advanced and Molecular Pharmacology	2
CBS 787	Pharmacokinetics	3
Crop Science		
CS 411	Crop Ecology	3
CS 414	Weed Science	4
CS 415	Integrated Pest Management	3
CS 430	Advanced Agroecology	4
CS 717	Weed Management Systems	1
Economics		
EC 404	Money, Financial Markets, and the Economy	3
EC 410	Public Finance	3
EC 413	Industrial Organization	3
EC 431	Labor Economics	3
EC 437		3
EC 449	International Finance	3
EC 451	Econometrics II	3
EC 474	Economics of Financial Institutions and Markets	3
ECG 505	Applied Microeconomic Analysis	3
ECG 506	Applied Macroeconomic Analysis	3
ECG 512	Law and Economics	3
ECG 515	Environmental and Resource Policy	3
ECG 537	Health Economics	3
ECG 540	Economic Development	3
ECG 700	Fundamentals of Microeconomics	3
ECG 703	Fundamentals of Macroeconomics	3
ECG 706	Industrial Organization	3
ECG 715	Environmental and Resource Economics	3
ECG 730	Labor Economics	3
ECG 741	Agricultural Production and Supply	3
ECG 742	Consumption, Demand and Market Interdependency	3
ECG 748	Theory Of International Trade	3
ECG 749	Monetary Aspects Of International Trade	3
Entomology		
ENT 425	General Entomology	3
ENT 503	Insect Morphology and Physiology	3
ENT 550	Fundamentals of Arthropod Management	3
ENT 582	Medical and Veterinary Entomology	3

ENT 726	Biological Control of Insects and Weeds	3
ENT 762	Insect Pest Management In Agricultural Crops	3
Food Science		
FS 402	Chemistry of Food and Bioprocessed Materials	4
FS 403	Analytical Techniques in Food & Bioprocessing Science	4
FS 405	Food Microbiology	3
FS 406	Food Microbiology Lab	1
FS 416	Quality Control in Food and Bioprocessing	3
FS 421	Food Preservation	3
FS 453	Food Laws and Regulations	3
FS 462	Postharvest Physiology	3
FS 520	Pre-Harvest Food Safety	3
FS 530	Post-Harvest Food Safety	3
FS 540	Food Safety and Public Health	3
FS 553	Food Laws and Regulations	3
FS 554	Lactation, Milk, and Nutrition	3
FS 555	Exercise Nutrition	3
FS 562	Postharvest Physiology	3
FS 567	Sensory Analysis of Foods	3
FS 580	Professional Development and Ethics in Food Safety	1
FS 725	Fermentation Microbiology	3
Fisheries and Wildlife Sciences		
FW 453	Principles of Wildlife Science	4
FW 515	Fish Physiology	3
FW 553	Principles of Wildlife Science	3
FW 560	International Wildlife Management and Conservation	3
FW 586	Aquaculture	3
Genetics		
GN 701	Molecular Genetics	3
GN 702	Cellular and Developmental Genetics	3
GN 703	Population and Quantitative Genetics	3
GN 708	Genetics of Animal Improvement	3
GN 713	Quantitative Genetics and Breeding	3
GN 721	Genetic Data Analysis	3
GN 735	Functional Genomics	3
GN 740	Evolutionary Genetics	3
GN 750	Developmental Genetics	3
GN 755	Population Genetics	3
GN 757	Quantitative Genetics Theory and Methods	3
GN 761	Advanced Molecular Biology Of the Cell	3
GN 768	Nucleic Acids: Structure and Function	3
Immunology		
IMM 705	Immunotoxicology	2
IMM 751	Immunology	3
IMM 783	Advanced Immunology	3
Microbiology		
MB 405	Food Microbiology	3
MB 406	Food Microbiology Lab	1
MB 411	Medical Microbiology	3
MB 412	Medical Microbiology Laboratory	1

MB 414	Microbial Metabolic Regulation	3
MB 441	Immunology	3
MB 451	Microbial Diversity	3
MB 455	Microbial Biotechnology	3
MB 461	Molecular Virology	3
MB 714	Microbial Metabolic Regulation	3
MB 718	Introductory Virology	3
MB 725	Fermentation Microbiology	3
MB 751	Immunology	3
MB 758	Microbial Genetics & Genomics	3
MB 783	Advanced Immunology	3
Nutrition		
NTR 420	Applied Nutrition Education	3
NTR 500	Principles of Human Nutrition	3
NTR 550	Applied Ruminant Nutrition	3
NTR 554	Lactation, Milk, and Nutrition	3
NTR 555	Exercise Nutrition	3
NTR 701	Protein and Amino Acid Metabolism	3
NTR 706	Vitamin Metabolism	3
NTR 708	Energy Metabolism	3
NTR 764	Advances in Gastrointestinal Pathophysiology	3
NTR 775	Mineral Metabolism	3
NTR 785	Digestion and Metabolism in Ruminants	3
Philosophy		
PHI 420	Global Justice	3
PHI 425	Introduction to Cognitive Science	3
PHI 440	The Scientific Method	3
PHI 475	Ethical Theory	3
PHI 520	Global Justice	3
PHI 540	The Scientific Method	3
PHI 575	Ethical Theory	3
PHI 816	Introduction to Research Ethics	1
Physiology		
PHY 503	General Physiology I	3
PHY 504	General Physiology II	3
PHY 524	Comparative Endocrinology	3
PHY 552	Comparative Reproductive Physiology and Biotechnology	3
PHY 702	Reproductive Physiology of Mammals	3
PHY 764	Advances in Gastrointestinal Pathophysiology	3
PHY 780	Mammalian Endocrinology	3
Poultry Science		
PO 410	Production and Management of Game Birds in Confinement	3
PO 421	Commercial Egg Production	3
PO 424	Poultry Meat Production	3
PO 435	Poultry Incubation & Breeding	4
PO 524	Comparative Endocrinology	3
PO 566	Animal Cell Culture Techniques	2
PO 757	Comparative Immunology	3
PO 775	Mineral Metabolism	3
Plant Pathology		
PP 530	Agriculture, Ethics and the Environment	3
Soil Science		
SSC 440	Geographic Information Systems (GIS) in Soil Science and Agriculture	3
SSC 452	Soil Classification	4

SSC 461	Soil Physical Properties and Plant Growth	3
SSC 462	Soil-Crop Management Systems	3
SSC 470	Wetland Soils	3
SSC 532	Soil Microbiology	4
SSC 541	Soil Fertility	3
SSC 545	Remote Sensing Applications in Soil Science and Agriculture	3
SSC 551	Soil Morphology, Genesis and Classification	3
SSC 562	Environmental Applications Of Soil Science	3
SSC 570	Wetland Soils	3
Statistics		
ST 430	Introduction to Regression Analysis	3
ST 431	Introduction to Experimental Design	3
ST 432	Introduction to Survey Sampling	3
ST 435	Statistical Methods for Quality and Productivity Improvement	3
ST 445	Introduction to Statistical Computing and Data Management	3
ST 505	Applied Nonparametric Statistics	3
ST 506	Sampling Animal Populations	3
ST 511	Statistical Methods For Researchers I	3
ST 512	Statistical Methods For Researchers II	3
ST 520	Statistical Principles of Clinical Trials	3
ST 524	Statistics In Plant Science	3
ST 546	Probability and Stochastic Processes I	3
ST 708	Applied Least Squares	3
ST 711	Design Of Experiments	3
ST 715	Theory Of Sampling Applied To Survey Design	3
ST 721	Genetic Data Analysis	3
ST 730	Applied Time Series Analysis	3
ST 732	Longitudinal Data Analysis	3
ST 733	Spatial Statistics	3
ST 747	Probability and Stochastic Processes II	3
ST 748	Stochastic Differential Equations	3
ST 757	Quantitative Genetics Theory and Methods	3
ST 771	Biomathematics I	3
ST 772	Biomathematics II	3
Toxicology		
TOX 401	Principles of Toxicology	4
TOX 415	Environmental Toxicology and Chemistry	4
TOX 501	Principles of Toxicology	4
TOX 701	Fundamentals of Toxicology	3
TOX 704	Chemical Risk Assessment	1
TOX 710	Molecular and Biochemical Toxicology	3
TOX 715	Environmental Toxicology	3
TOX 727	Pesticide Behavior and Fate In the Environment	2
TOX 771	Cancer Biology	4
Zoology		
ZO 512	Animal Symbiosis	3
ZO 513	Comparative Physiology	3
ZO 522	Biological Clocks	3
ZO 524		3
ZO 542	Herpetology	3

ZO 553	Principles Of Wildlife Science	3
ZO 582	Medical and Veterinary Entomology	3
ZO 790	Special Topics	1-6
ZO 791	Topics In Animal Behavior	3

Additional Requirements

- No more than two (2) credit hours of a seminar to be included in the 36 credit hour total
- A minimum of one full academic year or its equivalent in residence as a graduate student at the university
- The non-thesis Master of Animal Science degree requires a minimum of 36 credit hours, of which a minimum of 9 credits are in Animal Science courses at the 500 or above level
- Non-thesis programs may include no more than three (3) hours of independent student study credits of special topics project (ANS 610) in the minimum 36-credit program
- Research credit is not permitted in non-thesis programs, except upon approval by an associate dean of the Graduate School in cases where the student was initially enrolled in a thesis program but later transferred to a non-thesis program
- 400-level ANS courses are not permitted in a graduate plan of work
- No more than six (6) hours of 400-level courses from outside departments may be counted toward the 36-credit hour requirement
- Non-Thesis Masters Examination (ANS 690) credits may not be used to satisfy the 36-credit hour requirement
- Non-Thesis Masters Continuous Registration (ANS 688 and ANS 689) credits may NOT be sure to satisfy the 36-credit hour requirement
- No more than three (3) credit hours of Masters supervised teaching (ANS 685) may be included in the minimum 36-credit hour program
- A graduate mentor (advisor) is required
- Mentor certification of a graduate plan of work and program completion
- Meet with the graduate mentor at last once per semester
- Complete the annual graduate student progress report
- Committee not required, oral examination not required
- The director of graduate programs (https://cals.ncsu.edu/animal-science/people/joan/) and the Graduate School (https://grad.ncsu.edu/) must approve the graduate plan of work

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

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Douglas Wyatt Newcom

Theo A. van Kempen

Rasha Qudsieh

Animal Science (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**4**	
ANS 601	Animal Science Seminar		
ANS 610	Topical Problems in Animal Science (Safety and Ethics in Animal Science)		
ANS 685	Master's Supervised Teaching		
ANS 695	Master's Thesis Research		
or ANS 693	Master's Supervised Research		
Graduate Elective Courses		**18**	
Select any 500 - 700 level courses determined in conjunction with the advisory committee.			
Elective Courses [1]		**8**	
Select any "Elective Courses" determined in conjunction with the advisory committee.			
Total Hours		**30**	

[1] Students may choose 8 credits in combination of: ANS 693 Master's Supervised Research/ANS 695 Master's Thesis Research, Seminar, ANS 685 Master's Supervised Teaching, and other elective graded courses.

Additional Requirements & Restrictions

- A minimum of one (1) full academic year or its equivalent in residence as a graduate student at the university
- A minimum of 30 semester hours of graduate work in the degree program, unless the specific program requires more hours, including a minimum of 18 hours of 500-700 level coursework
- No more than six (6) hours of 400-level courses can be counted toward the minimum 30-hour requirement, and they may not come from the major field

- No more than three (3) credit hours of Masters Supervised Teaching (ANS 685) can be included in the minimum 30-credit program
- No more than six hours of Thesis Research (ANS 693 Master's Supervised Research/ANS 695 Master's Thesis Research) in the minimum 30-hour program
- No more than two (2) credit hours of seminar (S/U graded) may be included in the minimum 30-credit hour program
- Masters Thesis Preparation (ANS 699) credits may not be used to satisfy the 30-credit hour requirement
- A thesis
- A departmental defense seminar
- A comprehensive oral examination

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Glen William Almond

Joan Eisemann

Charlotte E. Farin

Vivek Fellner

William Lucas Flowers IV

Fikret Isik

Sung Woo Kim

Duane K. Larick

Hsiao-Ching Liu

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Animal Science (Minor)

Plan Requirements

Courses are determined in conjunction with an animal science faculty member on the graduate committee.

Code	Title	Hours	Counts towards
Required Courses		**10**	
Select minimum of nine credit hours of animal science courses at the 500-level or 700-level [1, 2]			
One (1) credit hour of animal science seminar			
Total Hours		**10**	

1. Students must maintain a minimum 3.0 GPA for 500-level and 700-level courses.
2. Students may take additional animal science courses at the 600-level or 800-level.

Faculty

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Animal Science and Poultry Science

A doctoral degree in Animal Science and Poultry Science with a concentration in either Animal Science or Poultry Science is offered. Specific course requirements are flexible and each student's program is developed in consultation with their Ph.D. advisory committee. The minor is optional but if a minor is included, external faculty representation is required on the advisory committee.

There are two curriculum codes for the Animal Science and Poultry Science doctoral degree program. If a student is interested in a program concentration in Animal Science, the appropriate curriculum code for the admissions application is ANA. If the student is interested in a program concentration in Poultry Science, the appropriate curriculum code for the admissions application is ANP. **If the appropriate curriculum code is not selected, it will delay the department's receipt of the applicant’s information from the Graduate School.**

Note: The Master's programs in Animal Science or Poultry Science are administered independently by each department.

Animal Science Concentration (ANA)

Admission Requirements

Factors considered for admission include: grade point average, scores on the GRE, undergraduate and graduate courses, experiences, statement of interest, and letters of recommendation. In addition, a member of the Department of Animal Science Graduate Faculty must be willing to serve as the applicant's advisor.

Student Financial Support

The Department of Animal Science offers a limited number of research and teaching assistantships that are awarded on a competitive basis. Students are also supported by research grant funds awarded to faculty members. The total support package includes health insurance, tuition, and a stipend. Students applying for these assistantships should apply by January 31 for fall admission.

Other Relevant Information

To provide an opportunity for students to develop their teaching skills, graduate students are required to assist in the departmental teaching program regardless of source of financial support. All graduate students in the Department of Animal Science who are mentored by departmental graduate faculty members are required to teach a minimum of one semester during their Ph.D. program.

Click on Graduate Courses - Animal Science (p. 97) for current course information.

Poultry Science Concentration (ANP)

Click on Graduate Courses - Poultry Science (p. 99) for current course information.

Degrees

PhD

- Animal Science & Poultry Science (PhD): Animal Science Concentration (p. 97)
- Animal Science & Poultry Science (PhD): Poultry Science Concentration (p. 99)

Minor

No results were found.

Faculty

Full Professors

Glen William Almond

Kenneth E. Anderson

Christopher M. Ashwell

Donna K. Carver

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Zehava Uni

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Michael John Wineland

Animal Science & Poultry Science (PhD): Animal Science Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3**	
ANS 601	Animal Science Seminar		
ANS 810	Topical Problems in Animal Science		
ANS 885	Doctoral Supervised Teaching		
Graduate Electives / Research Credits / Teaching Credits		**69**	
"Graduate Electives / Research Credits / Teaching Credits" are determined in conjunction with the advisory committee to meet the 72 total hours			
Total Hours		**72**	

Additional Requirements and Restrictions

- At least two residence credit points secured in continuous semesters' residence as a graduate student at the university
- Doctoral degrees at NC State require a minimum of 72 graduate credit hours beyond the Bachelor's degree
- For a student who already holds a master's degree upon initial admission to the doctoral program of study, a maximum of 18 hours of relevant graduate credit from the master's degree may be applied toward this minimum upon the recommendation of the student's graduate advisory committee. Therefore, the minimum credit-hour requirement, in this case, is 54 credit hours
- If a student completes a master's degree at NC State and chooses to continue on for a doctoral degree thereby maintaining a continuous registration status, up to 36 credit hours taken while in masters status may be used to meet minimum requirements for the doctoral degree
- Students cannot take 400-level courses or lower as part of the credit-hour requirement for the doctoral program of study
- Students cannot transfer courses into a Ph.D. program (including those taken in PBS status)
- A successful preliminary comprehensive examination which includes both written and oral components
- A dissertation
- Departmental defense seminar
- A final comprehensive oral examination

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Animal Science & Poultry Science (PhD): Poultry Science Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**10**	
PO 801	Graduate Seminar In Poultry Science		
PO 885	Doctoral Supervised Teaching		
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BCH 451	Principles of Biochemistry		

or BCH 553	Biochemistry of Gene Expression	
Graduate Electives / Research Courses		**62**
"Graduate Electives / Research Courses" that will be applied to reach 72 credit hours will be determined in conjunction with the advisory committee.		
Students are encouraged to choose these courses from the "Graduate Elective Courses" and "Graduate Research Courses" listed below		
Total Hours		**72**

Graduate Electives

Code	Title	Hours	Counts towards
Students are encouraged to select from the courses below:			
PO 504	Avian Anatomy and Physiology	4	
PO 506	Physiological Aspects of Poultry Management	3	
PO 510	Poultry Product Safety: An On-Farm Model	3	
PO 515	Comparative Nutrition	3	
PO 524	Comparative Endocrinology	3	
FM 525	Feed Manufacturing Technology	3	
PO 533	Poultry Processing and Products	3	
FM 580	Feed and Ingrdient Quality Assurance	3	
PO 590	Special Problems in Poultry Science	1-6	
FM 790	Advanced Feed Formulation	3	
IMM 757	Comparative Immunology	3	

Graduate Research Courses

Code	Title	Hours	Counts towards
Students are encouraged to choose from the following courses:			
PO 893	Doctoral Supervised Research	1-9	
PO 895	Doctoral Dissertation Research	1-9	
PO 899	Doctoral Dissertation Preparation	1-9	

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Biochemistry

Biochemistry as a discipline serves a pivotal role in advancing research in the Life Sciences. Through a combination of coursework, seminars, and original research, you will complete a Graduate degree and acquire the skills needed to become an independent research scientist. Our major research training areas emphasize:

- Structural and Analytical Biochemistry
- Molecular and Systems Biology
- Metabolism and Disease

Degrees earned will be distributed as: "Master of Biochemistry", "Master of Science", and "Doctor of Philosophy" without focus area specifications.

Brief Overview of Programs

- The accelerated Bachelor's / Master's Degree (ABM) is a 5-year dual degree program intended for undergraduate majors who wish to continue beyond the B.S. degree and receive additional training at the graduate level. Interested students who meet the minimum University GPA requirement are typically accepted into the program at the end of their junior year of undergraduate study. The Master's degree obtained after 5 years may be a Master's of Biochemistry (non-thesis) or a Master's of Science (thesis research) depending upon the selection made by the student.
- The Master's of Biochemistry is a non-thesis alternative to the Master's of Science degree in Biochemistry for students wishing to emphasize course work rather than thesis research. The Master's of Biochemistry is a terminal graduate degree and is not appropriate for students intending to pursue a Ph.D. program.
- The Master's of Science is a research degree that prepares students in Biochemistry for Ph.D. studies or provides training for technical employment.
- The objective of the Ph.D. program is to prepare students for careers as researchers primarily in academic, industrial, or government research environments.

Admission Requirements

Students entering the graduate program in biochemistry should have a bachelor's degree in biochemistry, chemistry or a related physical or biological science, including undergraduate courses in organic chemistry, calculus, physics and physical chemistry, as well as biochemistry/ molecular biology. Applicants with a strong record of undergraduate research activity or with practical experience in a professional scientific setting are particularly encouraged to apply. Reporting of GRE scores is strongly encouraged.

ABM Specific Admission Requirements

- a minimum of seventy-five credit hours in their undergraduate programs, including credits earned from advanced placement, but prior to the completion of their bachelor's.
- a minimum overall undergraduate grade point average (GPA) of 3.500 at NC State at the time of admission into the ABM program.
- (This GPA must be maintained throughout their undergraduate program to remain in the ABM program.)
- receive a grade of B or better in the double counted graduate-level courses (500 or 700 level) while maintaining a 3.50 GPA.
- (Courses with a grade of B- or below cannot be double counted between the two degrees.)
- maintain a 3.50 or better Biochemistry Major GPA.
- be positioned to complete the BS degree requirements by the end of their fourth year, and formally apply for admission to the Graduate School.
- one letter of recommendation from the proposed faculty mentor, indicating the qualifications of the student and willingness to serve as the Master's advisor.

Degrees

- Biochemistry (MR) (p. 103)
- Biochemistry (MS) (p. 104)
- Biochemistry (PhD) (p. 106)
- Biochemistry (Minor) (p. 107)

Faculty

Joe Barycki

Dennis Brown

Linda Kay Hanley-Bowdoin

Eric S. Miller

Melanie Simpson

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Michael B. Goshe

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Thomas Makris

Flora Meilleur

Robert B. Rose

Joshua J. Strable

Guozhou Xu

Ruben Rellan Alvarez

Abdulkerim Eroglu

Arion Kennedy

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Harold E. Swaisgood

Elizabeth C. Theil

Paul L. Wollenzien

Jason Locasale

Michael Milburn

Whitney Stutts

Peter Thompson

Biochemistry (MR)

Master's Degree Requirements

Degrees earned will be distributed as: "Master of Biochemistry" without focus area specifications.

Code	Title	Hours	Counts towards
Core Courses		**13**	
BCH 701	Macromolecular Structure		
BCH 703	Macromolecular Synthesis and Regulation		
BCH 705	Molecular Biology Of the Cell		
BCH 801	Seminar In Biochemistry [1]		
Elective Courses		**17**	
See "Elective Courses" listed below [2]			
Total Hours		**30**	

[1] Every semester for 2 years, 4 credit hours total; 1/semester

[2] Students may choose other courses approved in conjunction with the academic committee

Elective Courses

Code	Title	Hours	Counts towards
Select courses from any category below		**17**	
Molecular and Structural Biochemistry			
BCH 555	Proteins and Molecular Mechanisms	3	
BCH 590	Special Topics in Biochemistry	1-6	
BCH 770	Enzyme Kinetics and Mechanisms	3	
BCH 760	Protein Crystallography and Macromolecular Modeling	3	
Plant and Microbial Biology			
MB 414	Microbial Metabolic Regulation	3	
MB 505	Food Microbiology	3	
PB 580	Introduction to Plant Biotechnology	3	
PB 595	Special Topics in Plant Biology	1-6	
HS 701	Plant Metabolism	1	
MB 725	Fermentation Microbiology	3	
Food, Bioprocessing and Nutrition Science			
NTR 419	Human Nutrition and Chronic Disease	3	
NTR 500	Principles of Human Nutrition	3	

NTR 501	Advanced Nutrition and Metabolism	3
NTR 510	Maternal and Infant Nutrition	3
NTR 555	Exercise Nutrition	3
NTR 557	Nutraceuticals and Functional Foods	3
NTR 785	Digestion and Metabolism in Ruminants	3
Physiology		
PHY 503	General Physiology I	3
PHY 504	General Physiology II	3
PHY 780	Mammalian Endocrinology	3
Animal Science		
ANS/BCH 571	Regulation of Metabolism	3
ANS 701	Protein and Amino Acid Metabolism	3
ANS 709	Energy Metabolism	3
Prestage Poultry Science		
PO 504	Avian Anatomy and Physiology	4

Additional Requirements

- Successful completion of the Master's degree requires a minimum of 30 credit hours.
- At least 24 credit hours of letter-graded courses (“A,” “B,” “C”, etc.) must be included in the program.

Faculty

Joe Barycki

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Biochemistry (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**13**	
BCH 701	Macromolecular Structure		
BCH 703	Macromolecular Synthesis and Regulation		
BCH 705	Molecular Biology Of the Cell		

BCH 801	Seminar In Biochemistry [1]	
Elective Courses		**11**
See "Elective Courses" listed below [2, 3]		
Thesis		**6**
BCH 695	Master's Thesis Research [2]	
Total Hours		**30**

1. Every semester for 2 years, 4 credit hours total; 1/semester
2. Students may choose other courses approved in conjunction with the academic committee
3. Credit hours flexible to meet 30 total hours

Elective Courses

Code	Title	Hours	Counts towards
Select at least three courses below:		**9**	
BCH 552	Experimental Biochemistry	3	
BCH 553	Biochemistry of Gene Expression	3	
BCH 555	Proteins and Molecular Mechanisms	3	
BCH 560	Molecular Biology for Teachers	3	
BCH 571	Regulation of Metabolism	3	
BCH 590	Special Topics in Biochemistry	1-6	
BCH 701	Macromolecular Structure	3	
BCH 703	Macromolecular Synthesis and Regulation	3	
BCH 705	Molecular Biology Of the Cell	3	
BCH 710	Biological Scanning Electron Microscopy	2	
BCH 751	Biophysical Chemistry	3	
BCH 760	Protein Crystallography and Macromolecular Modeling	3	
BCH 761	Advanced Molecular Biology Of the Cell	3	
BCH 763	Biochemistry Of Hormone Action	3	
BCH 768	Nucleic Acids: Structure and Function	3	
BCH 770	Enzyme Kinetics and Mechanisms	3	

Additional Requirements

- Successful completion of the M.S. degree requires a minimum of 30 credit hours.
- At least 18 credit hours of letter-graded courses (“A,” “B,” “C”, etc.) must be included in the program.

Accelerated Bachelor's/Master's Degree Requirements

In addition to the standard University and Biochemistry requirements for a B.S. in Biochemistry, students must complete 30 credit hours at the graduate level for the Master’s degree component. This is accomplished as outlined below:

Code	Title	Hours	Counts towards
Undergraduate Core Courses		**6**	
BCH 552	Experimental Biochemistry		
BCH 553	Biochemistry of Gene Expression		
or BCH 555	Proteins and Molecular Mechanisms		
400-level Courses with a 500-level Counterpart [1, 2]		**6**	
See "400/500 Level Courses" listed below			
Graduate Core Courses [1, 2]		**12**	
BCH 701	Macromolecular Structure		
BCH 703	Macromolecular Synthesis and Regulation		
BCH 705	Molecular Biology Of the Cell		
Select one additional course:			
GN 701	Molecular Genetics		
BCH/GN 761	Advanced Molecular Biology Of the Cell		
MB 714	Microbial Metabolic Regulation		
MB 718	Introductory Virology		
PO 757	Comparative Immunology		
Research/Scholarship/Education Course		**6**	

BCH 685	Master's Supervised Teaching	
BCH 693	Master's Supervised Research	
BCH 695	Master's Thesis Research	
Total Hours		**30**

1 Indicates courses double counted for both Bachelor's and Master's degree

2 Students may choose other courses approved in conjunction with the academic committee

400/500-Level Courses

Code	Title	Hours	Counts towards
Select two courses listed below:		**6**	
CH 463/563	Molecular Origins of Life		
BIO 488/588	Neurobiology		
GN 441/541	Human and Biomedical Genetics		

Faculty

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Dennis Brown

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Eric S. Miller

Melanie Simpson

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Michael B. Goshe

Charles C. Hardin

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Flora Meilleur

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Paul L. Wollenzien

Jason Locasale

Michael Milburn

Whitney Stutts

Peter Thompson

Biochemistry (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**30**	
BCH 701	Macromolecular Structure (First semester - Fall)		
BCH 703	Macromolecular Synthesis and Regulation (Second Semester - Spring)		
BCH 705	Molecular Biology Of the Cell (Third Semester - Fall)		
BCH 801	Seminar In Biochemistry [1]		
BCH 870	Laboratory Rotations (First semester - Fall) [2]		
BCH 810	Special Topics (First semester - Fall)		

BCH 815	Advanced Special Topics (Second Semester - Spring)	
BCH 895	Doctoral Dissertation Research [3]	
Biochemistry / Related Course		**3**
Select 1 advanced course in biochemistry or related approved in conjunction with the academic committee		
Additional Courses		**39**
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours [3]		
Total Hours		**72**

[1] Every semester for 4 years, 8 credit hours total; 1/semester

[2] First semester in program - except for targeted students

[3] add to reach 72 credit hours

Additional Requirements

- Successful completion of the Ph.D. degree requires a minimum of 72 credit hours.
- At least 18 credit hours of formal coursework must be included in the program.

Faculty

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Whitney Stutts

Peter Thompson

Biochemistry (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Biological and Agricultural Engineering

Admission Requirements

A baccalaureate in biological or agricultural engineering or other engineering discipline (GPA > 2.8) is the preferred prerequisite for admission. Those with a strong academic background in the physical or biological sciences may also be admitted with a requirement for undergraduate work in math, physics, chemistry and basic engineering courses. In the case of applicants with Master's degrees, a Master's GPA of at least 3.2 is required for admission to the PhD. Exceptions to the overall undergraduate GPA requirements may be made for cases where performance in the major or during the last two years was at or above the 3.00 level.

Applicants who do not have an engineering background, but have earned a degree in an appropriate science discipline may be admitted to the Systems Analysis Concentration in the MS or PhD program without completing the engineering prerequisites.

GRE scores are required for all applicants. A faculty review committee will admit the best-qualified applicants.

Degrees

- Biological and Agricultural Engineering (MR) (p. 109)
- Biological and Agricultural Engineering (MS) (p. 110)
- Biological and Agricultural Engineering (MS): Systems Analysis Concentration (p. 111)
- Biological and Agricultural Engineering (PhD) (p. 113)
- Biological and Agricultural Engineering (PhD): Systems Analysis Concentration (p. 114)

Faculty

Full Professors

Michael D. Boyette

Michael R. Burchell II

Jay Jiayang Cheng

Mari S. Chinn

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Larry F. Stikeleather

Daniel H. Willits

Adjunct Professors

Christopher R Daubert

Ratna Rani Sharma

Biological and Agricultural Engineering (MR)

Degree Requirements

Code	Title	Hours	Counts towards
BAE Courses		**18**	
"BAE Courses" are determined in conjunction with the academic committee			
Mathematics / Statistics / Biomathematics Course		**3**	
The "Mathematics / Statistics / Biomathematics Course" is determined in conjunction with the academic committee			
Elective Courses		**9**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total credit hours			
Total Hours		**30**	

Additional Requirements

- 20/30 hours must come from 500 level and above
- maximum 6 hours S/U graded courses

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Ratna Rani Sharma

Biological and Agricultural Engineering (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**2**	
BAE 591	Master's Research Methods I		
BAE 592	Master's Research Methods II		
Math / Statistics / Biomathematics Courses		**6**	
The required "Mathematics / Statistics / Biomathematics Courses" are determined in conjunction with the academic committee			
Elective Courses [1, 2]		**22**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total credit hours			
Total Hours		**30**	

1 Minimum of 20 credit hours must come from 500-level and above courses

2 Maximum 6 hours S/U graded courses

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Biological and Agricultural Engineering (MS): Systems Analysis Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**2**	
BAE 591	Master's Research Methods I		
BAE 592	Master's Research Methods II		
Math / Statistics / Biomathematics Courses		**6**	
The required "Mathematics / Statistics / Biomathematics Courses" are determined in conjunction with the academic committee			
Elective Courses [1, 2]		**22**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total credit hours			
Total Hours		**30**	

1. Minimum of 20 credit hours must come from 500-level and above courses
2. Maximum 6 hours S/U graded courses

Concentration Electives

Code	Title	Hours	Counts towards
A minimum of 6 hours of elective courses must be taken from the following courses:		**6**	
BAE 501	Sensors and Controls	3	
BAE 527/427	Metabolic Systems Analysis		
BAE 535	Precision Agriculture Technology	3	

BAE 541	Foundation Tools to Agriculture, Food and Life Sciences Data	
BAE 542/542	Advanced Analytics to Agriculture, Food and Life Sciences Data	
BAE 555	R Coding for Data Management and Analysis	
BAE 565	Environmental and Agricultural Analytics and Modeling	3
GIS 512	Introduction to Environmental Remote Sensing	3
MEA 582	Geospatial Modeling	3

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Ratna Rani Sharma

Biological and Agricultural Engineering (PhD)

Degree Requirement

Code	Title	Hours	Counts towards
Required Courses		**5**	
BAE 791	Doctoral Research Methods I		
BAE 792	Doctoral Research Methods II		
BAE 885	Doctoral Supervised Teaching		
Mathematics / Statistics / Biomathematics Courses		**6**	
"Mathematics / Statistics / Biomathematics Courses" are determined in conjunction with the academic committee			
Minor Courses		**9**	
Students must select a minor, by which courses are determined in conjunction with the academic committee			
Elective Courses [1]		**52**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 72 total credit hours			
Total Hours		**72**	

[1] Students with a previous Master's Degree are only required to complete 54 total hours

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Ratna Rani Sharma

Biological and Agricultural Engineering (PhD): Systems Analysis Concentration

Degree Requirement

Code	Title	Hours	Counts towards
Required Courses		**5**	
BAE 791	Doctoral Research Methods I		
BAE 792	Doctoral Research Methods II		
BAE 885	Doctoral Supervised Teaching		
Mathematics / Statistics / Biomathematics Courses		**6**	
"Mathematics / Statistics / Biomathematics Courses" are determined in conjunction with the academic committee			
Minor Courses		**9**	
Students must select a minor, by which courses are determined in conjunction with the academic committee			
Elective Courses [1]		**52**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 72 total credit hours			
Total Hours		**72**	

[1] Students with a previous Master's Degree are only required to complete 54 total hours

Concentration Elective Courses

Code	Title	Hours	Counts towards
A minimum of 6 hours of elective courses must be taken from the following courses:		**6**	
BAE 501	Sensors and Controls	3	
BAE 527/427	Metabolic Systems Analysis		
BAE 535	Precision Agriculture Technology	3	
BAE 541	Foundation Tools to Agriculture, Food and Life Sciences Data		
BAE 542/542	Advanced Analytics to Agriculture, Food and Life Sciences Data		
BAE 555	R Coding for Data Management and Analysis		
BAE 565	Environmental and Agricultural Analytics and Modeling	3	
GIS 512	Introduction to Environmental Remote Sensing	3	
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Daniel H. Willits

Adjunct Professors

Christopher R Daubert

Ratna Rani Sharma

Biology

Areas of study include: cell biology, physiology, ecology, evolution, behavior, and fisheries, wildlife and conservation biology. Specializations within these areas include developmental biology, neurobiology, genomics, invertebrate biology, animal reproduction, biorhythms, behavioral ecology, community ecology, population ecology, conservation biology, fisheries ecology, wildlife field studies, aquaculture and others.

Degrees earned will be distributed as: "Master of Biology", "Master of Science", and "Doctor of Philosophy" without area of study, specialization, or track specifications.

Application Deadlines

To guarantee consideration for funding, applications should be complete by the following dates: for Fall Semester admission both U.S. and international applicants should have their application materials completed by January 15; for Spring Semester the deadline is October 15 for U.S. applicants and international applicants. Please note that it typically requires four to six weeks from the date of your request until transcripts and letters of recommendation reach us. Applications received after the dates listed above will still be considered until the Graduate School deadlines (June 25 and November 25 for U.S. applicants, March 1 and July 15 for international applicants); however, opportunities for funding may be limited (note that the Biology Graduate Program does not accept M.S. and Ph.D. students without support).

Admission Requirements

It is important that you identify a potential faculty adviser, as this will greatly increase your chance of admission to NCSU’s Biology Graduate Program. Although all applications are made available to faculty advisers for review, a graduate student will not be admitted to the Biology Program for graduate studies unless the prospective student has identified a faculty adviser. Once a faculty adviser has requested review of a prospective student, the application is then evaluated with regard to the applicant’s potential for success in graduate school. The admissions process involves consideration of the ability of our program to accommodate students.

Successful applicants usually have a Bachelor’s degree in Biological Sciences or a related field with at least an overall B average and a minimum number of courses in biology (and related fields) and supporting fields (6 in biology, 4 in chemistry, 2 in physics, and 2 in mathematics). In addition to the applicant's grades and coursework, we consider relevant experience (e.g., through internships, research experiences, volunteer or paid work, and publications), statement of interest, and letters of recommendation. GRE scores are not required. We expect applicants for the MS degree to have at least a 3.0 GPA, and applicants for the PhD degree to have at least a 3.2 GPA. Research experience is highly recommended.

Master's Degree Requirements

AEC 502 and PHI 816 (or equivalent) are required. No more than six hours of temporary courses (AEC 624, BIO 624, INB 624, BIO 824) or two hours of departmental seminar can be included in the 30-hour requirement for the M.S. Six hours of research credits (INB 695) resulting in a thesis are required. A minor (usually 9-10 hours) is optional. Other requirements may be imposed by the advisor.

Doctoral Degree Requirements

AEC 502 and PHI 816 (or equivalent) are required. A student's advisory committee recommends appropriate courses which will provide a strong foundation in the student's area of interest. A minimum of 10 hours of research (INB 895) leading to a dissertation is required. A minor (usually

9-10 hours) is optional. Other requirements may be imposed by the advisor.

Student Financial Support

Graduate teaching and research assistantships are available to well-qualified M.R., M.S. and Ph.D. students.

Other Relevant Information

Excellent research facilities, equipment and computers are available. Off-campus research is conducted at the Pamlico Aquaculture Field Laboratory, research and extension centers in Eastern and Western North Carolina, the Center for Marine Science and Technology in Morehead City, and at facilities of state and federal agencies and private organizations. Field work can be conducted at nearby natural areas and laboratory work at various state and federal laboratories associated with the department, nationally, and internationally.

Degrees

- Biology (MR) (p. 117)
- Biology (MS) (p. 119)
- Biology (PhD) (p. 124)

Full Professors

David Derek Aday

Betty L. Black

Russell J. Borski

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Trudy F. MacKay

Alexa J. McKerrow

Gerard McMahon

James Adiel Morris Jr.

Jennifer R Runkle

Megan Elizabeth Serr

Rowland M. Shelley

Kyle W. Shertzer

Adrian Alan Smith

Seth Patrick Stapleton

Bryan Lynn Stuart

Adam J. Terando

Biology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**3**	
AEC 502	Introduction to Biological Research		
PHI 816	Introduction to Research Ethics (or equivalent ethics course)		
Additional Coursework		**27**	
The additional courses that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee based on academic and job interests			
Total Hours		**30**	

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Jennifer R Runkle

Megan Elizabeth Serr

Rowland M. Shelley

Kyle W. Shertzer

Adrian Alan Smith

Seth Patrick Stapleton

Bryan Lynn Stuart

Adam J. Terando

Biology (MS)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science" without track specifications.

Code	Title	Hours	Counts towards
Core Courses		**3**	
AEC 502	Introduction to Biological Research		
PHI 816	Introduction to Research Ethics (or equivalent ethics course) [1]		
Additional Courses		**27**	
Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours			
Total Hours		**30**	

[1] Students may take PHI 816 Introduction to Research Ethics or equivalent to meet this requirement.

Aquaculture and Aquatic Sciences Track

Code	Title	Hours	Counts towards
Quantitative Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BIT 815	Advanced Special Topics [2]		

AEC 510	Machine Learning Approaches in Biological Sciences	
ST 505	Applied Nonparametric Statistics	
BMA 567	Modeling of Biological Systems	
Restricted Elective		**3**
Select one of the following courses:		
AEC/ENT 509	Ecology and Conservation of Freshwater Invertebrates	
AEC 515	Fish Physiology	
AEC 519	Freshwater Ecology	
AEC 624	Advanced Fisheries Science	
AEC 592	Special Topics in Applied Ecology (Management of Small Impoundments)	
AEC 592	Special Topics in Applied Ecology (Aquatic Plant Ecology)	
AEC 592	Special Topics in Applied Ecology (Advanced Biology of Fishes)	
AEC 624	Advanced Fisheries Science	
AEC 710	Sampling Animal Populations	
AEC 726	Quantitative Fisheries Management	
BMA 772	Biomathematics II	
FW 511	Human Dimensions of Wildlife and Fisheries	
MEA 549	Principles of Biological Oceanography	
NR 595	Special Topics in Natural Resources	
TOX 715	Environmental Toxicology	
ZO 524		
Total Hours		**6**

[2] BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

Molecular, Cellular and Developmental Biology Track

Code	Title	Hours	Counts towards
Quantitative Biology Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BIT 815	Advanced Special Topics [2]		
AEC 510	Machine Learning Approaches in Biological Sciences		
Biotechnology Requirement		**4**	
Select one course from the following:			
BIO 592	Topical Problems (Capstone Course in Molecular, Cellular, and Developmental Biology)		
GN 701	Molecular Genetics		
GN 702	Cellular and Developmental Genetics		
GN 750	Developmental Genetics		
Restricted Electives		**3**	
Select one of the following courses determined in conjunction with the academic committee based on thesis research			
BIT 510	Core Technologies in Molecular and Cellular Biology		
BIT 595	Special Topics		
Total Hours		**10**	

[2] BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

Ecology and Evolution Track

Code	Title	Hours	Counts towards
Quantitative Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
AEC 510	Machine Learning Approaches in Biological Sciences		
ST 505	Applied Nonparametric Statistics		
BMA 567	Modeling of Biological Systems		
Ecology or Evolution Requirement		**3**	
Select one of the following courses from "Ecology" or "Evolution"			
Ecology			
AEC 503	Foundations of Ecology		
AEC 519	Freshwater Ecology		
AEC 718	Community Ecology		
AEC 761	Conservation and Climate Science		
BIO/BMA 560	Population Ecology		
MEA 752	Marine Plankton Ecology		
Evolution			
BIO 570	Evolutionary Ecology		
ENT 591	Special Topics In Entomology		
GN 703	Population and Quantitative Genetics		
GN 713	Quantitative Genetics and Breeding		
GN 740	Evolutionary Genetics		
GN 757	Quantitative Genetics Theory and Methods		
PB 503	Systematic Botany		
PB 545	Paleobotany		
Total Hours		**6**	

Code	Title	Hours	Counts towards
Quantitative Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
AEC 510	Machine Learning Approaches in Biological Sciences		
ST 505	Applied Nonparametric Statistics		
BMA 567	Modeling of Biological Systems		
Ecology Requirement		**3**	
AEC 503	Foundations of Ecology		
AEC 519	Freshwater Ecology		
AEC 718	Community Ecology		
AEC 761	Conservation and Climate Science		
BIO/BMA 560	Population Ecology		
MEA 752	Marine Plankton Ecology		
Evolution Requirement		**3**	
BIO 570	Evolutionary Ecology		
ENT 591	Special Topics In Entomology		
GN 703	Population and Quantitative Genetics		
GN 713	Quantitative Genetics and Breeding		
GN 740	Evolutionary Genetics		
GN 757	Quantitative Genetics Theory and Methods		
PB 503	Systematic Botany		
PB 545	Paleobotany		
Total Hours		**9**	

Code	Title	Hours	Counts towards
Restricted Electives		**4**	
BIO 520	Skeletal Biological Laboratory Methods in Human Identification & Cold Cases		
BIO 811	Forensic Sciences Seminar		
Quantitative Requirements		**9**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
ST 540	Applied Bayesian Analysis		
Total Hours		**13**	

Other Requirements

- Every student is required to complete training logs. Many of the modules can be completed while taking the BIO 520 course. Please contact the Forensic Sciences Concentration Chair for additional information.
- Students are also required to start the Training Case Record Form after their first year and/or after taking BIO 520, whichever comes first. Please contact the Forensic Sciences Concentration Chair for additional information.
- Forensic Anthropology Society of Europe Level II Certification is strongly recommended but not required- costs associated with this exam are the student's responsibility.

Integrative Biology Track

This concentration is open to MS and PhD students who do not fit academically within the other Biology concentrations, or who integrate across multiple concentrations. Coursework is determined in consultation with your PhD mentor and committee and is approved by the DGP.

Full Professors

David Derek Aday

Betty L. Black

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David Buchwalter

Jeffrey A. Buckel

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Jaime A. Collazo

William Gregory Cope

Harry Valentine Daniels III

Robert R. Dunn

David B. Eggleston

John R. Godwin

Kevin Gross

Craig A. Harms

Jeffrey M. Hinshaw

Rebecca Elizabeth Irwin

Thomas J. Kwak

Thomas M. Losordo

Carolyn Jane Mattingly

Heather B. Patisaul

Luis Alonso Ramirez-Ulate

Ann Helen Ross

Mary Higby Schweitzer

David R. Tarpy

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Adam Hartstone-Rose

Randall Brian Langerhans

John Edward Meitzen

Nanette M. Nascone-Yoder

Marianne Niedzlek-Feaver

Antonio Planchart

Reade Bruce Roberts

Assistant Professors

Jie Cao

Khara Deanne Grieger

Nathan James Hostetter

Kurt Marsden

Jamian Krishna Pacifici

Seema Nayan Sheth

Caitlin Suzanne Smukowski Heil

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Bradley William Taylor

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Rowland M. Shelley

Kyle W. Shertzer

Adrian Alan Smith

Seth Patrick Stapleton

Bryan Lynn Stuart

Adam J. Terando

Biology (PhD)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Biology" without track specifications.

Code	Title	Hours	Counts towards
Core Courses		**3**	
AEC 502	Introduction to Biological Research		
PHI 816	Introduction to Research Ethics		
Additional Courses		**69**	
"Additional Courses" are determined in conjunction with the academic committee to meet the 72 total hours			
Total Hours		**72**	

Aquaculture and Aquatic Sciences Track

Code	Title	Hours	Counts towards
Quantitative Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BIT 815	Advanced Special Topics [2]		
AEC 510	Machine Learning Approaches in Biological Sciences		
ST 505	Applied Nonparametric Statistics		
BMA 567	Modeling of Biological Systems		
Restricted Elective		**6**	
Select two of the following courses:			
AEC/ENT 509	Ecology and Conservation of Freshwater Invertebrates		
AEC 515	Fish Physiology		
AEC 519	Freshwater Ecology		
AEC 624	Advanced Fisheries Science		
AEC 592	Special Topics in Applied Ecology (Management of Small Impoundments)		
AEC 592	Special Topics in Applied Ecology (Aquatic Plant Ecology)		
AEC 592	Special Topics in Applied Ecology (Advanced Biology of Fishes)		
AEC 624	Advanced Fisheries Science		
AEC 710	Sampling Animal Populations		
AEC 726	Quantitative Fisheries Management		
BMA 772	Biomathematics II		
FW 511	Human Dimensions of Wildlife and Fisheries		
MEA 549	Principles of Biological Oceanography		
NR 595	Special Topics in Natural Resources		
TOX 715	Environmental Toxicology		
ZO 524			
Total Hours		**9**	

[2] BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

Molecular, Cellular and Developmental Biology Track

Code	Title	Hours	Counts towards
Quantitative Biology Requirement		**3**	
Select one of the following courses:			
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BIT 815	Advanced Special Topics [2]		

AEC 510	Machine Learning Approaches in Biological Sciences	
Restricted Elective		**3**
Select one course from the following:		
BIO 592	Topical Problems (Capstone Course in Molecular, Cellular, and Developmental Biology)	
GN 701	Molecular Genetics	
GN 702	Cellular and Developmental Genetics	
GN 750	Developmental Genetics	
Biotechnology Requirement		**4**
Select one course below determined in conjunction with the academic committee based on thesis research		
BIT 510	Core Technologies in Molecular and Cellular Biology	
BIT 595	Special Topics	
Total Hours		**10**

[2] BIT 815 or any Bioinformatics course determined in conjunction with the academic committee.

Ecology and Evolution Track

Code	Title	Hours	Counts towards
Quantitative Requirement		**3**	
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
AEC 510	Machine Learning Approaches in Biological Sciences		
ST 505	Applied Nonparametric Statistics		
BMA 567	Modeling of Biological Systems		
Ecology Requirement		**3**	
AEC 503	Foundations of Ecology		
AEC 519	Freshwater Ecology		
AEC 718	Community Ecology		
AEC 761	Conservation and Climate Science		
BIO/BMA 560	Population Ecology		
MEA 752	Marine Plankton Ecology		
Evolution Requirement		**3**	
BIO 570	Evolutionary Ecology		
ENT 591	Special Topics In Entomology		
GN 703	Population and Quantitative Genetics		
GN 713	Quantitative Genetics and Breeding		
GN 740	Evolutionary Genetics		
GN 757	Quantitative Genetics Theory and Methods		
PB 503	Systematic Botany		
PB 545	Paleobotany		
Total Hours		**9**	

Forensic Sciences Track

Code	Title	Hours	Counts towards
Restricted Electives		**4**	
BIO 520	Skeletal Biological Laboratory Methods in Human Identification & Cold Cases		
BIO 811	Forensic Sciences Seminar		
Quantitative Requirements		**9**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
ST 540	Applied Bayesian Analysis		
Total Hours		**13**	

OTHER REQUIREMENTS

- Every student is required to complete training logs. Many of the modules can be completed while taking the BIO 520 course. Please contact the Forensic Sciences Concentration Chair for additional information.
- Students are also required to start the Training Case Record Form after their first year and/or after taking BIO 520, whichever comes first. Please contact the Forensic Sciences Concentration Chair for additional information.
- Forensic Anthropology Society of Europe Level II Certification is strongly recommended but not required- costs associated with this exam are the student's responsibility.

Physiology and Behavior Track

Code	Title	Hours	Counts towards
Quantitative Biology Requirement		**3**	
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BIT 815	Advanced Special Topics [1]		
AEC 510	Machine Learning Approaches in Biological Sciences		
ST 505	Applied Nonparametric Statistics		
BMA 567	Modeling of Biological Systems		
Restricted Electives		**6**	
Select two of the following courses:			
AEC/ENT 509	Ecology and Conservation of Freshwater Invertebrates		
AEC 515	Fish Physiology		
AEC 519	Freshwater Ecology		
AEC 624	Advanced Fisheries Science		
AEC 592	Special Topics in Applied Ecology (Management of Small Impoundments)		
AEC 592	Special Topics in Applied Ecology (Aquatic Plant Ecology)		
AEC 592	Special Topics in Applied Ecology (Advanced Biology of Fishes)		
AEC 624	Advanced Fisheries Science		
AEC 710	Sampling Animal Populations		
AEC 726	Quantitative Fisheries Management		
BMA 772	Biomathematics II		
FW 511	Human Dimensions of Wildlife and Fisheries		
MEA 549	Principles of Biological Oceanography		
NR 595	Special Topics in Natural Resources		
TOX 715	Environmental Toxicology		
ZO 524			
Additional Courses		**63**	
Additional courses are determined in conjunction with the academic committee to meet the 72 total hours			
Total Hours		**72**	

[1] Students may take PHI 816 Introduction to Research Ethics or equivalent to meet this requirement.

Integrative Biology Track

This concentration is open to MS and PhD students who do not fit academically within the other Biology concentrations, or who integrate across multiple concentrations. Coursework is determined in consultation with your PhD mentor and committee and is approved by the DGP.

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Bryan Lynn Stuart

Adam J. Terando

Crop Science

The Graduate Program in Crop Science revolves around our vision of being a world leader in Crop Science education and in the generation and application of knowledge required for economically and environmentally sustainable crop systems and products, as well as in developing land management strategies that protect the quality of North Carolina's soil, water and air resources.

Our mission within the Graduate program is to develop future leaders in Crop Science with a focus on improving crop plants and products, devising effective and sustainable crop production systems and effective and sustainable management techniques in both agricultural and urban settings; and dissemination of crop science knowledge for the benefit of users and producers of food, feed, turf, biofuels and fiber in North Carolina, the nation and the world.

The specific program areas in which Graduate education focuses are crop management and physiology, plant breeding and genetics, weed science, alternative crops and pesticide fate and impact on the environment.

Entrance requirements for the Graduate program in Crop Science follow the NC State Graduate School guidelines. A minimum of a 3.0 GPA at the Baccalaureate or master's level is required, although exceptions may be made for master's applicants with a very strong GPA in science classes and/or their final two years, or with substantial post-baccalaureate work experience. Students accepted will typically have a bachelor's or master's degree in crop science, or closely related fields, with strong preparation in the biological and physical sciences. The Graduate Record Examination is also required but there is no minimum score on any of the sections.

Financial assistance in the form of a Graduate Assistantship is available for most of the students accepted into the program. However, funding is limited and positions are highly competitive within a major professor's program area. It is recommended that applicants review the department's faculty listing and communicate directly with faculty members who have similar interest to theirs.

Degrees

- Crop Science (MR) (p. 130)
- Crop Science (MS) (p. 131)
- Crop Science (PhD) (p. 133)
- Crop Science (Minor) (p. 134)

Faculty

Adjunct Professors

Gina Brown-Guedira

Kent O. Burkey

Thomas E. Carter

Miguel S. Castillo

Guy D. Collins

Richard J. Cooper

Ralph E. Dewey

Keith L. Edmisten

Loren Ray Fisher

Major M. Goodman

Candace H. Haigler

Ronnie W. Heiniger

James B. Holland

David L. Jordan

Vasu Kuraparthy

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Michelle S. Schroeder-Moreno

Randy Wells

Fred H. Yelverton

Wesley J. Everman

Travis W. Gannon

Ramon Gonzalo Leon Gonzalez

Matthew D. Krakowsky

Susana R. Milla-Lewis

Lori J. Unruh Snyder

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Jeffrey C. Dunne

Benjamin David Fallen

Joseph Lee Gage

Amanda M. Hulse-Kemp

Anna Locke

Angela R. Post

David H. Suchoff

Earl Taliercio

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Daryl T. Bowman

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Robert D. Keys

H. Michael Linker

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Gail G. McRae

J. Paul Mueller

Gerald F. Peedin

Rongda Qu

W. David Smith

Janet F. Spears

Harold T. Stalker, Jr.

Gene A. Sullivan

Donald L. Thompson

Jerome B. Weber

Arthur K. Weissinger

P. Randall Weisz

Earl A. Wernsman

A. Douglas Worsham

Johnny C. Wynne

Alan C. York

Thomas R. Sinclair

Research Scholars

Robert E. Austin

Assistant Professors

Amanda Avila Cardoso

Crop Science (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**36**	
CS 590	Special Topics (Required: 4-6 hours)		
CS 620	Special Problems		
CS 601	Seminar		
ST 511	Statistical Methods For Researchers I (or equivalent)		
Select a minimum of 20 credit hours at the 500- to 800-level approved in conjunction with the academic committee			
Total Hours		**36**	

Faculty

Adjunct Professors

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Crop Science (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**30**	
CS 695	Master's Thesis Research		
CS 601	Seminar		
ST 511	Statistical Methods For Researchers I (or equivalent)		
ST 512	Statistical Methods For Researchers II (or equivalent)		
Select a minimum of 20 credit hours at the 500- to 800-level approved in conjunction with the academic committee			
Total Hours		**30**	

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Crop Science (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**72**	
Select 72 hours of coursework determined in conjunction with the academic committee			
Total Hours		**72**	

Faculty

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S. Christopher Reberg-Horton

Robert J. Richardson

Thomas W. Rufty Jr.

Michelle S. Schroeder-Moreno

Randy Wells

Fred H. Yelverton

Wesley J. Everman

Travis W. Gannon

Ramon Gonzalo Leon Gonzalez

Matthew D. Krakowsky

Susana R. Milla-Lewis

Lori J. Unruh Snyder

Charles W. Cahoon

Jeffrey C. Dunne

Benjamin David Fallen

Joseph Lee Gage

Amanda M. Hulse-Kemp

Anna Locke

Angela R. Post

David H. Suchoff

Earl Taliercio

Matthew C. Vann

Rachel A. Vann

Daniel C. Bowman

Daryl T. Bowman

Arthur H. Bruneau

Joseph W. Burton

Harold D. Coble

William K. Collins

Will A. Cope

Frederick T. Corbin

David A. Danehower

James T. Green, Jr.

Harry D. Gross

Robert D. Keys

H. Michael Linker

Raymond C. Long

Jean-Marie Luginbuhl

Gail G. McRae

J. Paul Mueller

Gerald F. Peedin

Rongda Qu

W. David Smith

Janet F. Spears

Harold T. Stalker, Jr.

Gene A. Sullivan

Donald L. Thompson

Jerome B. Weber

Arthur K. Weissinger

P. Randall Weisz

Earl A. Wernsman

A. Douglas Worsham

Johnny C. Wynne

Alan C. York

Thomas R. Sinclair

Research Scholars

Robert E. Austin

Assistant Professors

Amanda Avila Cardoso

Crop Science (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Adjunct Professors

Gina Brown-Guedira

Kent O. Burkey

Thomas E. Carter

Miguel S. Castillo

Guy D. Collins

Richard J. Cooper

Ralph E. Dewey

Keith L. Edmisten

Loren Ray Fisher

Major M. Goodman

Candace H. Haigler

Ronnie W. Heiniger

James B. Holland

David L. Jordan

Vasu Kuraparthy

Ramsey S. Lewis

David P. Livingston III

David S. Marshall

Rouf M. Mian

Grady L. Miller

J. Paul Murphy

Robert P. Patterson

Charles H. Peacock

S. Christopher Reberg-Horton

Robert J. Richardson

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Johnny C. Wynne

Alan C. York

Thomas R. Sinclair

Research Scholars

Robert E. Austin

Assistant Professors

Amanda Avila Cardoso

Entomology

Course offerings or research facilities are available in the following areas: agricultural entomology, apiculture, aquatic entomology, behavior, biological control, chemical ecology, forest entomology, genetic pest management, host-plant resistance, insect ecology, insect transmission of plant pathogens, insect microbe interactions, medical and veterinary entomology, pest management, physiology, molecular biology, population genetics, insect symbiosis, urban ecology, urban entomology, systematics and toxicology.

Admission Requirements

Training in biology and appropriate courses in chemistry, biochemistry, mathematics and physics, is preferred. A "B" average (3.0 GPA) is required in biology courses and an overall 3.0 GPA during the last two years of the undergraduate program.

Master's Degree Requirements

A minimum of 30 credits are required for graduation 9 credits of letter grade entomology courses plus 2 credits of entomology student seminars are also required. The student’s advisory committee will meet with the student to identify an appropriate plan of course work.

Doctoral Degree Requirements

A minimum of 72 credits (18 may be transferred from a Master's degree) are required for graduation. For Ph.D. students 9 credits of letter grade entomology courses plus 3 credits of entomology student seminars are required. The student’s advisory committee will meet with the student to identify an appropriate plan of course work.

Student Financial Support

Graduate assistantships and other forms of aid are available to students as described in the Fellowships and Graduate Assistantships section of the Graduate Catalog.

Other Relevant Information

Full admission is permitted only after acceptable applicants have secured an advisor and appropriate financial support. All students are expected to begin their research as soon as possible.

Degrees

- Entomology (MR) (p. 137)
- Entomology (MS) (p. 138)
- Entomology (PhD) (p. 140)
- Entomology (PhD): Behavioral Biology Concentration (p. 141)
- Entomology (Minor) (p. 143)
- Genetic Engineering & Society (Minor) (p. 144)

Faculty

Full Professors

Rick Lynn Brandenburg

David Buchwalter

Wayne G. Buhler

Hannah J. Burrack

Robert R. Dunn

Steven D. Frank

Fred L. Gould

Rebecca Elizabeth Irwin

George G. Kennedy

Dominic Duane Reisig

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Herbert H. Neunzig

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Robert L. Robertson

Kenneth A. Sorensen

Phillip S. Southern

Ronald Edwin Stinner

John W. VanDuyn

Charles Gerald Wright

Adjunct Professors

Nicholas M. Haddad

Loganathan Ponnusamy

Christopher M. Ranger

Entomology (MR)

Degree Requirement

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of 3 courses from the following list:			
ENT 502	Insect Diversity		
ENT 503	Insect Morphology and Physiology		
ENT 504	Professional Development for Agriculture and the Life Sciences		
ENT 506	Principles of Genetic Pest Management		
ENT 509	Biology of Aquatic Insects		
ENT 510	Writing Proposals in Agriculture, Biology, and Ecology		
ENT 520	Insect Behavior		
ENT 526	Organic Agriculture: Principles and Practices		
ENT 550	Fundamentals of Arthropod Management		
ENT 560	Techniques in Molecular Ecology and Evolution		
ENT 582	Medical and Veterinary Entomology		
ENT 591	Special Topics In Entomology		
ENT 726	Biological Control of Insects and Weeds		
ENT 727	Ecology of Soil Ecosystems		
ENT 731	Insect Ecology		
ENT 762	Insect Pest Management In Agricultural Crops		
ENT 791	Special Topics In Entomology		
Seminar Courses		**2**	
Seminar course must be repeated to fulfill 2 credit hours			
ENT 601	Seminar		
or ENT 801	Seminar		
Additional Courses		**25**	
Additional Courses are determined in conjunction with the academic committee to meet the 36 total hours			
Total Hours		**36**	

Faculty

Full Professors

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Charles Gerald Wright

Adjunct Professors

Nicholas M. Haddad

Loganathan Ponnusamy

Christopher M. Ranger

Entomology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of 3 courses from the following list:			
ENT 502	Insect Diversity		
ENT 503	Insect Morphology and Physiology		
ENT 504	Professional Development for Agriculture and the Life Sciences		
ENT 506	Principles of Genetic Pest Management		
ENT 509	Biology of Aquatic Insects		
ENT 510	Writing Proposals in Agriculture, Biology, and Ecology		
ENT 520	Insect Behavior		
ENT 526	Organic Agriculture: Principles and Practices		
ENT 550	Fundamentals of Arthropod Management		
ENT 560	Techniques in Molecular Ecology and Evolution		
ENT 582	Medical and Veterinary Entomology		
ENT 591	Special Topics In Entomology		
ENT 726	Biological Control of Insects and Weeds		
ENT 727	Ecology of Soil Ecosystems		
ENT 731	Insect Ecology		

ENT 762	Insect Pest Management In Agricultural Crops	
ENT 791	Special Topics In Entomology	
Seminar Courses		**2**
Seminar course must be repeated to fulfill 2 credit hours		
ENT 601	Seminar	
or ENT 801	Seminar	
Additional Courses		**19**
Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours		
Total Hours		**30**

Faculty

Full Professors

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Christopher M. Ranger

Entomology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of 3 courses from the following list:			
ENT 502	Insect Diversity		
ENT 503	Insect Morphology and Physiology		
ENT 504	Professional Development for Agriculture and the Life Sciences		
ENT 506	Principles of Genetic Pest Management		
ENT 509	Biology of Aquatic Insects		
ENT 510	Writing Proposals in Agriculture, Biology, and Ecology		
ENT 520	Insect Behavior		
ENT 526	Organic Agriculture: Principles and Practices		
ENT 550	Fundamentals of Arthropod Management		
ENT 560	Techniques in Molecular Ecology and Evolution		
ENT 582	Medical and Veterinary Entomology		
ENT 591	Special Topics In Entomology		
ENT 726	Biological Control of Insects and Weeds		
ENT 727	Ecology of Soil Ecosystems		
ENT 731	Insect Ecology		
ENT 762	Insect Pest Management In Agricultural Crops		
ENT 791	Special Topics In Entomology		
Seminar Courses		**3**	
Seminar course must be repeated to fulfill 3 credit hours			
ENT 601	Seminar		
or ENT 801	Seminar		
Additional Courses		**60**	
Additional Courses are determined in conjunction with the academic committee to meet the 72 total hours			
Total Hours		**72**	

Faculty

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Charles Gerald Wright

Adjunct Professors

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Loganathan Ponnusamy

Christopher M. Ranger

Entomology (PhD): Behavioral Biology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of 3 courses from the following list:			
ENT 502	Insect Diversity		
ENT 503	Insect Morphology and Physiology		
ENT 504	Professional Development for Agriculture and the Life Sciences		
ENT 506	Principles of Genetic Pest Management		
ENT 509	Biology of Aquatic Insects		
ENT 510	Writing Proposals in Agriculture, Biology, and Ecology		
ENT 520	Insect Behavior		
ENT 526	Organic Agriculture: Principles and Practices		
ENT 550	Fundamentals of Arthropod Management		
ENT 560	Techniques in Molecular Ecology and Evolution		
ENT 582	Medical and Veterinary Entomology		
ENT 591	Special Topics In Entomology		
ENT 726	Biological Control of Insects and Weeds		
ENT 727	Ecology of Soil Ecosystems		
ENT 731	Insect Ecology		

ENT 762	Insect Pest Management In Agricultural Crops		
ENT 791	Special Topics In Entomology		
Seminar Courses		**3**	
Seminar course must be repeated to fulfill 3 credit hours			
ENT 601	Seminar		
or ENT 801	Seminar		

Code	Title	Hours	Counts towards
Behavioral Biology Concentration		**60**	
Complete the requirements for the Behavioral Biology Concentration determined in conjunction with the academic committee to meet the 72 total hours			
Total Hours		**72**	

Faculty

Full Professors

Rick Lynn Brandenburg

David Buchwalter

Wayne G. Buhler

Hannah J. Burrack

Robert R. Dunn

Steven D. Frank

Fred L. Gould

Rebecca Elizabeth Irwin

George G. Kennedy

Dominic Duane Reisig

Richard M. Roe

Coby J. Schal

Jules Silverman

Clyde E. Sorenson

David R. Tarpy

James F. Walgenbach

David W. Watson

Anna Elizabeth Whitfield

Brian M. Wiegmann

Associate professors

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David B. Orr

Michael Hay Reiskind

Dorith Rotenberg

Assistant Professors

Zachary Steven Brown

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Elsa Youngsteadt

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Phillip S. Southern

Ronald Edwin Stinner

John W. VanDuyn

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Adjunct Professors

Nicholas M. Haddad

Loganathan Ponnusamy

Christopher M. Ranger

Entomology (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select a minimum of three courses approved in conjunction with the academic committee – see "Entomology Courses" listed below		
Total Hours		**9**	

Entomology Courses

Code	Title	Hours	Counts towards
ENT 502	Insect Diversity	4	
ENT 503	Insect Morphology and Physiology	3	
ENT 504	Professional Development for Agriculture and the Life Sciences	2	
ENT 506	Principles of Genetic Pest Management	3	
ENT 509	Biology of Aquatic Insects	3	
ENT 510	Writing Proposals in Agriculture, Biology, and Ecology	2	
ENT 520	Insect Behavior	3	
ENT 526	Organic Agriculture: Principles and Practices	3	
ENT 550	Fundamentals of Arthropod Management	3	
ENT 560	Techniques in Molecular Ecology and Evolution	3	
ENT 582	Medical and Veterinary Entomology	3	
ENT 591	Special Topics In Entomology	1-6	
ENT 601	Seminar	1	
ENT 604	Insect Natural History and Field Ecology	1	
ENT 620	Special Problems	1-6	
ENT 641	Agricultural Entomology Practicum	3	
ENT 726	Biological Control of Insects and Weeds	3	
ENT 727	Ecology of Soil Ecosystems	3	
ENT 731	Insect Ecology	3	
ENT 762	Insect Pest Management In Agricultural Crops	3	
ENT 791	Special Topics In Entomology	1-6	
ENT 801	Seminar	1	
ENT 804	Insect Natural History and Field Ecology	1	
ENT 820	Special Problems	1-6	
ENT 841	Agricultural Entomology Practicum	3	

Faculty

Full Professors

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Hannah J. Burrack

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Charles Gerald Wright

Adjunct Professors

Nicholas M. Haddad

Loganathan Ponnusamy

Christopher M. Ranger

Genetic Engineering & Society (Minor)

The interdisciplinary minor in Genetic Engineering and Society (GES) examines the technological, societal and ecological issues surrounding the development and potential use of genetically engineered organisms. Participants in the minor will learn the basic concepts and principles underlying genetic engineering and the methods used for evaluating the technology's social, cultural and environmental dimensions. The graduate minor is available to students pursuing either an MS or a Ph.D. degree.

Requirements

In order to complete the minor, coursework must be taken in relevant areas of natural sciences and the humanities and social sciences. 9 credit hours from a list of approved courses (see below) are required, 6 of which must be two of the core GES courses. The remaining 3 credit hours must be fulfilled by a course from the list of approved courses that are outside the students' home discipline. A grade of B or higher must be achieved in each course counted towards the minor. In addition, a student must have a GES faculty member on his or her committee, and this faculty member should be from a discipline other than the student's major, ensuring that there is representation from both humanities/social science and natural science.

The choice of courses must be consistent with the interdisciplinary outlook of this minor, namely that students will learn the basic concepts and principles underlying genetic engineering and the methods used for evaluating the technology's social, cultural and environmental dimensions. The minor representative will be responsible for ensuring that the courses taken are appropriate and balance the student's major. Students in the biological sciences will be encouraged to take hands-on courses, such as those offered by the BIT program.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
GES/COM/HI 508	Emerging Technologies and Society		

GES 591	Special Topics in Genetic Engineering and Society (Governance, Systems & Modeling)	
GES 591	Special Topics in Genetic Engineering and Society (Genetic Engineering for Sustainable Crop Development)	
Select one additional course below:		**3**
GES 506	Principles of Genetic Pest Management	
ANT 550	Culture, Ecology, and Sustainable Living	
BIT 410/510	Manipulation of Recombinant DNA	
COM 536	Seminar in Environmental Communication	
ECG 540	Economic Development	
ENG 515	Rhetoric Of Science and Technology	
FW 411/511	Human Dimensions of Wildlife and Fisheries	
GN 735	Functional Genomics	
HI 540	American Environmental History	
HI 581	History of the Life Sciences	
HI 585	History of American Technology	
NR 571	Current Issues in Natural Resource Policy	
REL 571	Darwinism and Christianity	
PA 598/798	Special Topics in Public Administration (Science and Technology Policy)	
PHI 475/575	Ethical Theory	
PSY 757	Innovation and Technology	
ST 590	Special Topics (Bioinformatics I/ II)	
Total Hours		**12**

Faculty

Full Professors

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Phillip S. Southern

Ronald Edwin Stinner

John W. VanDuyn

Charles Gerald Wright

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Nicholas M. Haddad

Loganathan Ponnusamy

Christopher M. Ranger

Food Science

The department's professional activities include teaching, research, and extension functions. The program provides an educational, research, and informational center in food science for North Carolina and the nation. The department also houses two research centers, the Southeast Dairy Foods Research Center and the Center for Advanced Processing and Packaging Studies. Course offerings and research opportunities are available in the following areas: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology. The strategic directions of the faculty and staff are in the areas of: food safety and foodborne disease prevention; food manufacturing and entrepreneurship; education innovation and effectiveness; and, foods for health and well-being.

Degrees earned will be distributed as: "Master of Food Science", "Master of Science", and "Doctor of Philosophy" without research area specifications.

Admissions Requirements

To be admitted, a student should be a graduate of an accredited program in food science or the equivalent. Graduates of other majors can be admitted but will have additional course requirements. The best qualified applicants will be accepted up to the number of spaces that are available for new students. We only recommend admission to the M.S. or Ph.D. degree if a member of our research faculty is willing to advise the student’s research. Applications from qualified candidates will be reviewed by faculty seeking research students; conversely applicants may contact faculty whose research specialty is of interest to inquire about available positions. Admission to the Master of Food Science will be based on the qualifications of the applicants.

Master's Degree Requirements

A Master's program must include courses from at least two of the following categories: chemistry-biochemistry, engineering, microbiology, nutrition and processing technology. The M. S. in Food Science requires 30 credit hours of course work and research. The Master of Food Science requires 36 credit hours of course work, including an independent project and professional skills.

Doctoral Degree Requirements

A doctoral program must include courses from at least three of the categories listed above (or equivalent courses at another university). Total course credits will vary depending on the needs of the student and the requirements of the Graduate School. All doctoral students are required to pass a departmentally administered written preliminary exam, designed to evaluate a Ph.D. student's general knowledge and comprehension of food science.

Student Financial Support

Graduate assistantships and other forms of student aid available to students in this program are described elsewhere in the Graduate Catalog. Admission does not guarantee availability of financial support.

Other Relevant Information

Students are encouraged to make personal contact with individual faculty whose research program is of interest to them.

Degrees

- Food Science (MR) (p. 148)
- Food Science (MS) (p. 150)
- Food Science (PhD) (p. 152)
- Food Science (Minor) (p. 154)

Faculty

Adjunct Professors

Jonathan C. Allen

Kenneth E. Anderson

Rodolphe Barrangou

Frederick Breidt

Benjamin James Chapman

Patricia Ann Curtis

Lisa Louise Dean

Mary Anne Drake

Mario Giovanni Ferruzzi

Scott A. Hale

Hosni Moustafa Hassan

Lee-Ann Jaykus

Sophia Kathariou

Saad A. Khan

Duane K. Larick

Mary Ann Lila

Richard Linton

Muquarrab Qureshi

K. P. Sandeep

John Douglas Sheppard

April Fogleman

Lora Suzanne Goodell

Dana J. Hanson

Gabriel Keith Harris

Suzanne Dunn Johanningsmeier

Colin David Kay

Slavko Komarnytsky

Andrew Peter Neilson

Ilenys Muniz Perez-Diaz

Clinton Dale Stevenson

Alexander Vladimirovich Chouljenko

Natalie Kathleen Cooke

Lynette Marie Johnston

Marvin Leonel Moncada Reyes

Deepti Arvind Salvi

Ondulla Tyvette Toomer

Haotian Zheng

Fernanda Bottaro de Oliveira Santos

Josip Simunovic

Nicola Singletary

Sarah Liberman Ash

Leonard W. Aurand

Hershell R. Ball Jr

Leon Carl Boyd

Roy E. Carawan

Daniel E Carroll Jr

George L. Catignani

Edward Allen Foegeding

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Tawanda Muzhingi

Shengmin Sang

Ratna Rani Sharma

Richard C.Theuer

Food Science (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select six hours of coursework listed under "Core Courses" approved in conjunction with the academic committee			
Select an additional six hours of coursework listed under either "Core Courses" or "Elective Courses" approved in conjunction with the academic commitee			
Seminar Course		**1**	
FS 780	Seminar In Food Science		
Additional Courses		**17**	
"Additional Courses" are approved in conjunction with the academic committee *			
Internship / Research Course		**6**	
FS 620	Special Problems In Food Science		
or FS 693	Master's Supervised Research		
Total Hours		**36**	

* "Additional Courses" may include FS courses and/or interdisciplinary courses.

Core Courses

Code	Title	Hours	Counts towards
Select courses from at least two categories below:		**12**	
Chemistry-Biochemistry			
FS 567	Sensory Analysis of Foods	3	
Engineering			
FS 741	Thermal Processing of Foods	3	
Microbiology			
FS 540	Food Safety and Public Health	3	
FS 725	Fermentation Microbiology	3	
Nutrition			
FS 501	Advanced Nutrition and Metabolism	3	
FS 555	Exercise Nutrition	3	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 775	Mineral Metabolism	3	
Processing Technology			
FS 516	Quality Control in Food and Bioprocessing	3	
FS 522	Food Packaging	3	
FS 530	Post-Harvest Food Safety	3	
FS 535	Food Safety Management Systems	3	
FS 751	Food Ingredient Technology In Product Development	4	

Elective Courses

Code	Title	Hours	Counts towards
FS 520	Pre-Harvest Food Safety		
FS 526	Upstream Biomanufacturing Laboratory		
FS 550	Food Industry Study Tour		
FS 554	Lactation, Milk, and Nutrition		
FS 557	Nutraceuticals and Functional Foods		
FS 562	Postharvest Physiology		
FS 580	Professional Development and Ethics in Food Safety		

Additional courses may be selected in conjunction with the academic committee

Faculty

Adjunct Professors

Jonathan C. Allen

Kenneth E. Anderson

Rodolphe Barrangou

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Food Science (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select six hours of coursework listed under "Core Courses" approved in conjunction with the academic committee			
Select an additional six hours of coursework listed under either "Core Courses" or "Elective Courses" approved in conjunction with the academic committee			
Supervised Teaching Course		**1**	
FS 685	Master's Supervised Teaching		
Seminar Course		**1**	
FS 780	Seminar In Food Science		
Additional Courses		**10**	
"Additional Courses" will be determined in conjunction with the academic committee [1]			
Research Course		**6**	
FS 695	Master's Thesis Research [2]		
Total Hours		**30**	

1 "Additional Courses" may include FS courses, optional minor courses, and/or interdisciplinary courses.

2 Up to 6 credits of FS 695 Master's Thesis Research may be used toward the 30 total hours.

Core Courses

Code	Title	Hours	Counts towards
Select courses from at least two categories below:			
Chemistry-Biochemistry			
FS 567	Sensory Analysis of Foods	3	
Engineering			
FS 741	Thermal Processing of Foods	3	
Microbiology			
FS 540	Food Safety and Public Health	3	
FS 725	Fermentation Microbiology	3	
Nutrition			
FS 501	Advanced Nutrition and Metabolism	3	
FS 555	Exercise Nutrition	3	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 775	Mineral Metabolism	3	
Processing Technology			
FS 516	Quality Control in Food and Bioprocessing	3	
FS 522	Food Packaging	3	
FS 530	Post-Harvest Food Safety	3	
FS 535	Food Safety Management Systems	3	
FS 751	Food Ingredient Technology In Product Development	4	

Elective Courses

Code	Title	Hours	Counts towards
FS 520	Pre-Harvest Food Safety	3	
FS 526	Upstream Biomanufacturing Laboratory	2	
FS 550	Food Industry Study Tour	2	
FS 554	Lactation, Milk, and Nutrition	3	

FS 557	Nutraceuticals and Functional Foods	3
FS 562	Postharvest Physiology	3
FS 580	Professional Development and Ethics in Food Safety	1
Additional courses may be selected in conjunction with the academic committee		

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Food Science (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
Select nine hours of coursework listed under "Core Courses" approved in conjunction with the academic committee			
Select an additional six hours of coursework listed under either "Core Courses" or "Elective Courses" approved in conjunction with the academic committee			
Supervised Teaching Course		**2**	
FS 885	Doctoral Supervised Teaching [1]		
Seminar Course		**1**	
FS 780	Seminar In Food Science		
Research Ethics Course		**1**	
"Research Ethics" course will be determined in conjunction with the academic committee			
Additional Courses		**53**	
"Additional Courses" will be determined in conjunction with the academic committee to meet 72 total hours [2]			
Total Hours		**72**	

1 Two semesters of FS 885 Doctoral Supervised Teaching are required.

2 "Additional Courses" may include FS 895 Doctoral Dissertation Research, FS courses, optional minor courses, and/or interdisciplinary courses.

Core Courses

Code	Title	Hours	Counts towards
Select courses from at least three categories below:			
Chemistry-Biochemistry			
FS 567	Sensory Analysis of Foods	3	
Engineering			
FS 741	Thermal Processing of Foods	3	
Microbiology			
FS 540	Food Safety and Public Health	3	
FS 725	Fermentation Microbiology	3	
Nutrition			
FS 501	Advanced Nutrition and Metabolism	3	
FS 555	Exercise Nutrition	3	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 775	Mineral Metabolism	3	
Processing Technology			
FS 516	Quality Control in Food and Bioprocessing	3	
FS 522	Food Packaging	3	
FS 530	Post-Harvest Food Safety	3	
FS 535	Food Safety Management Systems	3	
FS 751	Food Ingredient Technology In Product Development	4	

Elective Courses

Code	Title	Hours	Counts towards
FS 520	Pre-Harvest Food Safety	3	
FS 526	Upstream Biomanufacturing Laboratory	2	
FS 550	Food Industry Study Tour	2	
FS 554	Lactation, Milk, and Nutrition	3	
FS 557	Nutraceuticals and Functional Foods	3	
FS 562	Postharvest Physiology	3	
FS 580	Professional Development and Ethics in Food Safety	1	
Additional courses may be approved in conjunction with the academic committee			

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Food Science (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine credit hours of graduate Food Science coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Food Science Courses

Code	Title	Hours	Counts towards
Food Science coursework includes the following courses:		**9**	
FS 403	Analytical Techniques in Food & Bioprocessing Science	4	
FS 501	Advanced Nutrition and Metabolism	3	
FS 502	Chemistry of Food and Bioprocessed Materials	4	
FS 505	Food Microbiology	3	
FS 506	Food Microbiology Lab	1	
FS 516	Quality Control in Food and Bioprocessing	3	
FS 520	Pre-Harvest Food Safety	3	
FS 521	Food Preservation	3	
FS 522	Food Packaging	3	
FS 526	Upstream Biomanufacturing Laboratory	2	
FS 530	Post-Harvest Food Safety	3	
FS 535	Food Safety Management Systems	3	
FS 540	Food Safety and Public Health	3	
FS 550	Food Industry Study Tour	2	
FS 554	Lactation, Milk, and Nutrition	3	
FS 555	Exercise Nutrition	3	
FS 557	Nutraceuticals and Functional Foods	3	
FS 562	Postharvest Physiology	3	
FS 567	Sensory Analysis of Foods	3	
FS 580	Professional Development and Ethics in Food Safety	1	
FS 725	Fermentation Microbiology	3	
FS 741	Thermal Processing of Foods	3	

FS 751	Food Ingredient Technology In Product Development	4
FS 780	Seminar In Food Science	1

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Horticultural Science

The Department offers graduate programs leading to the Master of Horticultural Science (non-thesis), Master of Science (thesis) and Doctor of Philosophy (thesis) degrees. Completion of the respective requirements normally takes 2 to 2 ½ years for the Masters and 3 to 3 ½ years for the Doctor of Philosophy. Studies may be oriented to floriculture, ornamental and landscape horticulture, pomology (fruit crops) or olericulture (vegetables). A variety of areas for study and research are available: plant physiology, breeding and genetics, herbicide physiology, nutrition, propagation, plant molecular biology and biotechnology, genomics, growth regulators, postharvest physiology, sustainable and organic agriculture, fruits, vegetables, floriculture, woody ornamentals, and landscape horticulture.

Facilities for graduate studies include 40,500 square feet of greenhouse space; the University Phytotron (available for controlled environmental studies on horticultural crops); 19 well-equipped laboratories; 14 controlled temperature storage rooms, an extensive collection of plant materials, both living and preserved; and a variety of climates and soils from coast to mountains in North Carolina on eighteen outlying research stations.

Admission to The Graduate School and the Department is competitive. Admission is usually limited to students with a grade point average of 3.00 or higher. Horticultural Science candidates should have completed course work in physics, mathematics (preferably calculus and statistics), chemistry, biochemistry, soils, plant pathology, genetics, plant physiology, entomology, genomics/bioformatics, botany/plant biology, cellular biology, molecular biology and several courses in horticulture. Landscape Horticulture candidates should have a complete landscape design background. An applicant deficient in course work may be admitted on a provisional basis until the deficiency is made up. Applicants must provide the basic Graduate Record Examination (GRE) scores, three letters of reference, an unofficial transcript for each previous degree, a personal statement and resume/CV. Applicants from other countries must also furnish evidence of proficiency in English (TOEFL, IELTS or Duolingo). TOELF or IELTS test date must be no older than two years (24 months) prior to the beginning of the requested entry term.

Financial assistance in the form of a Graduate Assistantship may be available for students accepted into the program. However, funding is limited and positions are highly competitive within a major professor's program area. You should contact the faculty within the department that are working in your area of interest to inquire about assistantship availability. Students must have a confirmed advisor for admission to the program.

Degrees

- Horticultural Science (MR) (p. 157)
- Horticultural Science (MS) (p. 158)
- Horticultural Science (PhD) (p. 159)
- Horticultural Science (Certificate) (p. 163)
- Horticultural Science (Minor) (p. 160)

Faculty

Lucy K. Bradley

Wayne G. Buhler

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Rebecca Diane Dunning

Remington Ariel Ham

Marcelo Mollinar

Reza Shekasteband

Adjunct Faculty

Charlotte D. Glen

Horticultural Science (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
HS 601	Professional Presentation Skills in Horticultural Science		
HS 693	Master's Supervised Research		
ST 511	Statistical Methods For Researchers I [1]		
ST 512	Statistical Methods For Researchers II [1]		
Core Courses [2]		**4**	
Select at least 4 courses from the following list:			
HS 703	Breeding Asexually Propagated Crops		
HS 704	Plant Nomenclature		
HS 705	Physiology Of Flowering		
HS 707	Environmental Stress Physiology		
CS 717	Weed Management Systems		
or HS 717	Weed Management Systems		
CS 725	Pesticide Chemistry		
or HS 725	Pesticide Chemistry		
Additional Courses [3]		**20**	
Additional Courses are determined in conjunction with the academic committee to meet the 36 total hours			
Total Hours		**36**	

1. Students have the option to take courses equivalent to ST 511 and ST 512 determined in conjunction with the academic committee.
2. **Core Courses** are optional and may be substituted with courses determined in conjunction with the academic committee.
3. At least 18 of the 36 credit hours must be letter-graded coursework at the 500- and 700-levels.

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Adjunct Faculty

Charlotte D. Glen

Horticultural Science (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
HS 601	Professional Presentation Skills in Horticultural Science		
HS 695	Master's Thesis Research		
ST 511	Statistical Methods For Researchers I [1]		
ST 512	Statistical Methods For Researchers II [1]		
Core Courses		**4**	
Select four of the following courses:			
HS 703	Breeding Asexually Propagated Crops		
HS 704	Plant Nomenclature		
HS 705	Physiology Of Flowering		
HS 707	Environmental Stress Physiology		
CS 717	Weed Management Systems		
or HS 717	Weed Management Systems		
CS 725	Pesticide Chemistry		
or HS 725	Pesticide Chemistry		
Additional Courses		**13**	
Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours [2]			
Total Hours		**26**	

1. Students have the option to take courses equivalent to ST 511 and ST 512 determined in conjunction with the academic committee.
2. The course credit hours must meet the following requirements: 20 credit hours at 500-700 level, 6 credit hours at 700 level, and 18 letter-graded credit hours.

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Adjunct Faculty

Charlotte D. Glen

Horticultural Science (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Course		**2**	
HS 601	Professional Presentation Skills in Horticultural Science		
Core Courses		**3**	
Select three of the following courses:		3	
HS 703	Breeding Asexually Propagated Crops		
HS 704	Plant Nomenclature		
HS 705	Physiology Of Flowering		
HS 707	Environmental Stress Physiology		
HS 717	Weed Management Systems		
or CS 717	Weed Management Systems		
HS 725	Pesticide Chemistry		
or CS 725	Pesticide Chemistry		
Additional Courses		**64**	
Additional Courses are determined in conjunction with the academic committee to meet the 72 total hours [1]			
Total Hours		**72**	

[1] Students must complete a minimum of 20 credit hours at 500 - 800-level courses; at least 18 credit hours must be letter-graded coursework.

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Charlotte D. Glen

Horticultural Science (Minor)

Plan Requirements

Master's Requirements

Code	Title	Hours	Counts towards
Required Courses			
400+ Level HS Courses		3	
500+ Level HS Courses		6	
Total Hours		**9**	

PhD Requirements

Code	Title	Hours	Counts towards
Required Courses			
500+ Level HS Courses		9	
Total Hours		**9**	

Horticultural Science Courses

Code	Title	Hours	Counts towards
See the above requirements to meet the minor requirements			
HS 400	Residential Landscaping	6	
HS 410	Community Food Systems	3	
HS 411	Nursery Management	3	
HS 416	Planting Design	4	
HS 418	Digital Media Graphic for Landscape Designers	3	
HS 420	Green Infrastructure	3	

HS 421	Temperate-Zone Tree Fruits: Physiology and Culture	3
HS 422	Small Fruit Production	3
HS 423	Viticulture	3
HS 428	Service-Learning in Urban Agriculture Systems	1
HS 431	Vegetable Production	4
HS 432	Introduction to Permaculture	3
HS 433	Public Garden Administration	3
HS 440	Greenhouse Management	3
HS 442	Floriculture Crop Production	3
HS 451	Plant Nutrition	3
HS 462	Postharvest Physiology	3
HS 471	Landscape Ecosystem Management	4
HS 475	Horticulture Entrepreneurship	3
HS 476	Crop Physiology and Production in Controlled Environments	3
HS 480	Sustainable Food Production (capstone)	1
HS 491	Sustainable Agriculture Entrepreneurship Study Abroad	3
HS 492	Horticulture Internship	1-3
HS 493	Research Experience in Horticultural Science	1-3
HS 494	Teaching Experience in Horticultural Science	1-3
HS 495	Experimental Courses in Horticultural Science	1-6
HS 502	Plant Disease: Methods & Diagnosis	2
HS 516	Planting Design	4
HS 520	Green Infrastructure	3
HS 521	Temperate-Zone Tree Fruits: Physiology and Culture	3
HS 523	Viticulture	3
HS 532	Introduction to Permaculture	3
HS 533	Public Garden Administration	3
HS 541	Plant Breeding Methods	3
HS 550	Environmental Nursery Production	3
HS 551	Plant Nutrition	3
HS 562	Postharvest Physiology	3
HS 576	Crop Physiology and Production in Controlled Environments	3
HS 583	Advanced Floral Crop Production and Handling	3
HS 590	Special Problems in Horticultural Science	1-6
HS 601	Professional Presentation Skills in Horticultural Science	2
HS 610	Special Topics in Horticultural Science	1-6
HS 615	Advanced Special Topics	1-6
HS 685	Master's Supervised Teaching	1-3
HS 688	Non-Thesis Masters Continuous Registration - Half Time Registration	1
HS 689	Non-Thesis Master Continuous Registration - Full Time Registration	3
HS 690	Master's Examination	1-9
HS 693	Master's Supervised Research	1-9

HS 695	Master's Thesis Research	1-9
HS 696	Summer Thesis Research	1
HS 699	Master's Thesis Preparation	1-9
HS 701	Plant Metabolism	1
HS 702	Biology of Plant Hormones	1
HS 703	Breeding Asexually Propagated Crops	1
HS 704	Plant Nomenclature	1
HS 705	Physiology Of Flowering	1
HS 706	Fruit Development and Postharvest Physiology	1
HS 707	Environmental Stress Physiology	1
HS 716	Weed Biology	3
HS 717	Weed Management Systems	1
HS 720	Molecular Biology In Plant Breeding	3
HS 725	Pesticide Chemistry	1
HS 727	Pesticide Behavior and Fate In the Environment	2
HS 729	Herbicide Behavior In Plants	2
HS 745	Quantitative Genetics In Plant Breeding	1
HS 746	Cytogenetics in Plant Breeding	2
HS 757	Quantitative Genetics Theory and Methods	3
HS 790	Special Problems in Horticultural Science	1-6
HS 815	Advanced Special Topics	1-6
HS 860	Plant Breeding Laboratory	1
HS 861	Plant Breeding Laboratory	1
HS 885	Doctoral Supervised Teaching	1-3
HS 890	Doctoral Preliminary Examination	1-9
HS 893	Doctoral Supervised Research	1-9
HS 895	Doctoral Dissertation Research	1-9
HS 896	Summer Dissertation Research	1
HS 899	Doctoral Dissertation Preparation	1-9

Faculty

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Nancy G. Creamer

John Martin Dole

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Carlos Ariel Iglesias Frascheri

William Carl Fonteno III

Christopher Gunter

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Todd Craig Wehner

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Barbara Fair

Ricardo Hernandez

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Anne McCombe Spafford

Hsuan Chen

Hamid Ashrafi

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Timothy Joseph Kelliher

Melinda Jean Knuth

Thomas Matthew Kon

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Remington Ariel Ham

Marcelo Mollinar

Reza Shekasteband

Adjunct Faculty

Charlotte D. Glen

Horticultural Science (Certificate)

The Graduate Certificate is a non-degree, designed to increase personal knowledge and skills for current or future employment in the horticulture industry. Earning the Graduate Certificate requires completing a minimum of 15 credit hours (usually equaling 5 courses) of coursework. Courses may be taken either on-line or face-to-face.

Participants must hold a bachelor's degree to enroll in this program. Graduate Certificate applicants should have majored in horticulture, crop science, plant science, or agricultural education with a concentration in plant science, or another closely related degree. Students may begin taking courses for the graduate certificate in Summer, Fall, or Spring. All graduate certificate course work must be completed within four years of enrollment.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of three courses from the following:			
HS 502	Plant Disease: Methods & Diagnosis		
HS 516	Planting Design		
HS 520	Green Infrastructure		
HS 521	Temperate-Zone Tree Fruits: Physiology and Culture		
HS 523	Viticulture		
HS 532	Introduction to Permaculture *		
HS 533	Public Garden Administration		
HS/CS 541	Plant Breeding Methods *		
HS 550	Environmental Nursery Production *		
HS 551	Plant Nutrition *		
HS/FS 562	Postharvest Physiology *		
HS 576	Crop Physiology and Production in Controlled Environments		
HS 601	Professional Presentation Skills in Horticultural Science *		
HS 703	Breeding Asexually Propagated Crops		
HS 704	Plant Nomenclature		
HS 705	Physiology Of Flowering		
HS 707	Environmental Stress Physiology		
HS 717	Weed Management Systems		
HS 725	Pesticide Chemistry		
HS 727	Pesticide Behavior and Fate In the Environment		
HS 757	Quantitative Genetics Theory and Methods		
Additional Courses [1]		**6**	

Additional Courses are determined in conjunction with the academic committee to meet the 15 total hours	
Total Hours	**15**

* Courses taught online

1 Students must take courses that meet the following requirements: must be at 500-level or higher, letter-graded, passed with a B or better

2 Students can select a maximum of 6 hours from the following subjects: ARE, AEE, BAE, CS, ENT, FS, PP, SCC; courses must be at 400-level or higher.

Microbial Biotechnology

The Master of Microbial Biotechnology Program (MMB) is recognized by the Council of Graduate Schools as a Professional Science Master's degree (PSM). The MMB degree combines training in Microbiology, Business and Biotechnology. This degree is specifically designed to prepare students for positions in the biotechnology, biopharmaceutical and agrobusiness industries. The program includes courses that involve semester-long interactions with local biotechnology companies as well as foundational courses in microbiology, business management and molecular biology.

Admission Requirements

Applications are invited from individuals holding B.S. or M.S. degrees in the physical and life sciences. Applications should be received before May 1 to be considered for Fall semester admission. The Graduate Record Exam (GRE) is required and should be taken sufficiently early so that scores can be submitted and evaluated along with the application. Other requirements include all relevant transcripts, three letters of recommendation and a personal statement that describes the applicant's career goals as well as why they are pursuing the MMB degree.

Master's Degree Requirements

The Master of Microbial Biotechnology (MMB) degree requires 40 credit hours, including four semesters involvement in an Industry Case Studies course, as well as a summer industry internship. This program also can be combined with a Master of Business Administration (MBA) offered through the College of Management.

Student Financial Support

A limited number of full-time participants in the Master of Microbial Biotechnology program may be eligible for Teaching Assistantships. The number of TA positions available varies every semester and there are no guaranteed positions. Students in the MMB program should assume that they will self-fund their education.

Degrees

- Microbial Biotechnology (MR) (p. 164)

Faculty

Full Professors

Jose Bruno-Barcena

Amy Michele Grunden

Christine Hawkes

Michael Hyman

Scott M. Laster

Eric S. Miller

Assistant Professors

Manuel Kleiner

Adjunct Faculty

Jason Caplan

Microbial Biotechnology (MR)

Master of Microbial Biotechnology Degree Requirements

Code	Title	Hours	Counts towards
Microbiology / Science Core Courses		**6**	
Select two of the following courses:			
MB 555	Microbial Biotechnology		
MB 714	Microbial Metabolic Regulation (Recommended)		
MB 751	Immunology		
MB 758	Microbial Genetics & Genomics		
MB 590	Topical Problems (Environmental Microbiology and Biotechnology)		
PB 580	Introduction to Plant Biotechnology		
Science Elective		**3**	
Select a course from "Science Electives" listed below			
Internship Course		**3**	
MB 620	Special Problems		
Industrial Case Studies		**12**	
MB 585	Industry Case Studies in Microbial Biotechnology		
MB 590	Topical Problems		

Biotechnology (BIT) / Biomanufacturing (BEC) Core Courses		**4**
BEC 525 & BEC 545	Molecular Biology for Biomanufacturing and Cell Line Development for Biomanufacturing [1]	
or BIT 510	Core Technologies in Molecular and Cellular Biology	
BIT or BEC Electives		**4**
Select two courses from "Biotechnology (BIT) and Biomanufacturing (BEC) Electives" listed below		
Business Core Course		**3**
MBA 585	Current Topics in BioSciences Management	
MBA Electives		**6**
Select two courses from "Master of Business Administration (MBA) Electives" listed below		
Total Hours		**41**

[1] Incoming students may be able to opt out of this requirement if they can provide sufficient evidence that indicates basic experience and understanding of technologies including recombinant DNA procedures, gene expression, isolation and identification of nucleic acids and proteins. Evidence may include a letter from current or former supervisors and/or professors attesting that the applicant possesses at least basic understanding and experience. Applicants with doctoral training in a related area may opt out of BIT 510 OR BEC 540, with MMB approval.

Science Electives

Code	Title	Hours	Counts towards
Select one course below			
Biological and Agricultural Engineering (BAE)			
BAE 525	Industrial Microbiology and Bioprocessing	3	
BAE 528	Biomass to Renewable Energy Processes	3	
Biochemistry (BCH)			
BCH 553	Biochemistry of Gene Expression	3	
BCH 555	Proteins and Molecular Mechanisms	3	
BCH 571	Regulation of Metabolism	3	
BCH 701	Macromolecular Structure	3	
BCH 703	Macromolecular Synthesis and Regulation	3	
BCH 705	Molecular Biology Of the Cell	3	
BCH 751	Biophysical Chemistry	3	
Comparative Biomedical Sciences (CBS)			
CBS 565	Fundamentals of Biomedical Sciences	3	
Food Science (FS)			
FS 502	Chemistry of Food and Bioprocessed Materials	4	
FS 553	Food Laws and Regulations	3	
Genetics (GN)			
GN 521	Molecular Genetics	3	
GN 730	Fungal Genetics and Physiology	3	
GN 735	Functional Genomics	3	
Microbiology (MB)			
MB 501	Biology of Plant Pathogens	3	
MB 505	Food Microbiology	3	
MB 532	Soil Microbiology	4	
MB 575	Introduction to Mycology	4	
MB 718	Introductory Virology	3	
MB 725	Fermentation Microbiology	3	
MB 730	Fungal Genetics and Physiology	3	
MB 751	Immunology	3	
MB 758	Microbial Genetics & Genomics	3	
MB 774	Phycology	3	
Plant Biology (PB)			
PB 580	Introduction to Plant Biotechnology	3	
Plant Pathology (PP)			

PP 530	Agriculture, Ethics and the Environment	3
Statistics (ST)		
ST 511	Statistical Methods For Researchers I	3
ST 512	Statistical Methods For Researchers II	3
ST 513	Statistics for Management and Social Sciences I	3
ST 520	Statistical Principles of Clinical Trials	3
Toxicology (TOX)		
TOX 515	Environmental Toxicology	4
TOX 710	Molecular and Biochemical Toxicology	3

Biotechnology (BIT) and Biomanufacturing (BEC) Electives

Code	Title	Hours	Counts towards
Select two courses below			
Biotechnology (BIT)			
BIT 501	Ethical Issues in Biotechnology	1	
BIT 562	Gene Expression Analysis: Microarrays	2	
BIT 563	Fermentation of Recombinant Microorganisms	2	
BIT 564	Protein Purification	2	
BIT 565	Real-time PCR Techniques	2	
BIT 566	Animal Cell Culture Techniques	2	
BIT 567	PCR and DNA Fingerprinting	2	
BIT 568	Genome Mapping	2	
BIT 569		2	
BIT 581	Plant Transformation	2	
BIT 595	Special Topics	1-6	
BIT 815	Advanced Special Topics	1-6	
Biomanufacturing (BEC)			
MB 520	Fundamentals of Microbial Cell Biotransformations	2	
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 575	Global Regulatory Affairs for Medical Products	3	
BEC 580	cGMP Fermentation Operations	2	
BEC 585	cGMP Downstream Operations	2	
BEC 595	Special Topics in Biomanufacturing	1-6	

Master of Business Administration (MBA) Electives

Code	Title	Hours	Counts towards
Select two courses below			
MBA 505	Essential Economics for Managers	2	
MBA 530	Leading People	3	
BUS 554	Project Management	3	
MBA 555	Product Design and Development	4	
MBA 570	Opportunity Evaluation and Value Creation	3	
MBA 576	Technology Entrepreneurship and Commercialization I	3	
MBA 577	Technology Entrepreneurship and Commercialization II	3	
MBA 586	Legal, Regulatory and Ethical Issues in Life Science Industries	3	
MBA 590	Special Topics In Business Management	1-6	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Full Professors

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Adjunct Faculty

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Microbiology

Microbiology is an integral part of the life science and biotechnology disciplines across the North Carolina State University campus. The Microbiology Graduate Program involves research and education in laboratories and departments that form inter-disciplinary teams to address critical, global challenges for science and society. The MGP (http://harvest.cals.ncsu.edu/microbiology/) offers courses of study and research leading to the Ph.D., M.S., Master of Microbiology (M.M.) and Master of Microbial Biotechnology (M.M.B.) degrees.

The research-based degrees (M.S and Ph.D.) offered by the program are designed to prepare students for careers in academic, industrial or research institute settings. Course offerings for Microbiology research students focus on microbial genetics and physiology, bioprocessing and fermentation, biotechnology, virology, immunology and host-pathogen interactions. Research throughout the program is diverse, emphasizing most areas where microbes, viruses and systems biology have relevance to basic science and biotechnology. Research opportunities for students involve many areas of specialization including biofuels, bioremediation, environmental microbiology, antibiotic resistance, extremophiles, bacterial pathogens, probiotics, developmental epigenetics, bacteriophages, inflammation modulation and viral pathogenesis; the list is long and broad. Financial support for study towards Ph.D. and M.S. degrees is limited, but can be available in the form of teaching/research assistantships and competitive fellowships.

The non-research-based Masters of Microbial Biotechnology (MMB) is a Professional Science Masters degree that combines concentrations in Microbiology, Business and Biotechnology. This degree is specifically designed to prepare students for positions in the biotechnology, biopharmaceutical and agrobusiness industries. The program includes courses that involve semester-long interactions with local biotechnology companies as well as foundational courses in microbiology, business management and molecular biology. The M.M. degree is a rigorous non-thesis degree that is designed for students who want a higher degree in microbiology but do not want to conduct research or are unable to commit to the time demands of a research degree. Many students in the M.M. program either work for local employers or are interested in subsequent applications to professional schools. Financial support is extremely limited for either M.M.B or M. M. students.

Admission Requirements

Applications are invited from individuals holding B.S. or M.S. degrees in the physical and life sciences. Applications should be received in the department before December 1st to be considered for Fall semester admission. Requirements include all relevant transcripts, three letters of recommendation and a personal statement that describes the applicant's academic and career goals as well as their area of interest.

Master's Degree Requirements

The Master of Science (M.S.) requires 30 credit hours, of which 18 must be graded, a written thesis and at least one semester of laboratory teaching experience. The Master of Microbial Biotechnology (M.M.B.; http://harvest.cals.ncsu.edu/master-of-microbial-biotechnology/mmb/) degree requires 40 credit hours and four semesters involvement in an Industry Case Studies course, as well as a summer industry internship. This program also can be combined with a Master of Business Administration (M.B.A.) offered through the College of Management. The Master of Microbiology (M.M.) requires 30 credit hours, of which 18 must be graded, but has no requirement for a written thesis or laboratory instruction).

Doctoral Degree Requirements

The Ph.D. program (http://harvest.cals.ncsu.edu/microbiology/) is designed for individuals desiring to pursue careers in research and/or teaching. Prospective Ph.D. and M.S. students should become aware of departmental research programs and faculty so that an area of specialization is indicated in the application materials (personal statement). A faculty dissertation advisor and laboratory research program are confirmed at admission or by the end of the first semester. In conjunction with the advisor, the student establishes a four-member faculty advisory committee to guide the research and academic program. At least one semester of teaching assistance / experience is required. A preliminary examination is held soon after completing the second year

of study, and the final examination includes a seminar presented by the candidate that is open to the university community.

Student Financial Support

All Ph.D. and M.S. applications to the Microbiology Graduate Program are considered for available assistantships. For highly qualified students, supplemental funds are frequently available. There is limited funding available for international students given the structure of the NC State University Graduate Student Support Plan.

Degrees

- Microbiology (MR) (p. 169)
- Microbiology (MS) (p. 170)
- Microbiology (PhD) (p. 173)
- Microbiology (Minor) (p. 175)

Faculty

Full Professors

Prema Arasu

Rodolphe Barrangou

Frederick Breidt

Dennis T. Brown

Jose Manuel Bruno-Barcena

Susan B. Carson

Mari S. Chinn

Marc A. Cubeta

Francis De Los Reyes

Robert R. Dunn

Frederick J. Fuller

Amy Michele Grunden

Hosni Moustafa Hassan

Christine Veronica Hawkes

Shuijin Hu

Michael Hyman

Lee-Ann Jaykus

Sophia Kathariou

Robert M. Kelly

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Cristina Lanzas

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Robert G. Upchurch

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Kevin Garcia

Angela Rose Harris

Manuel Kleiner

Aram Arshak Mikaelyan

Ryan William Paerl

Ilenys Muniz Perez Diaz

Casey Michelle Theriot

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Gerald Hugh Elkan

Michael Carl Flickinger

Todd Robert Klaenhammer

Wesley Edwin Kloos

Geraldine Luginbuhl

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Daniel van der Lelie

Microbiology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select at least four of the following courses:			
MB 535	Bacterial Pathogenesis		
MB 714	Microbial Metabolic Regulation		
MB 718	Introductory Virology		
MB 751	Immunology		
MB 758	Microbial Genetics & Genomics		
Elective Courses		**18**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total hours			
Total Hours		**30**	

Additional Requirements

- An annual "Graduate Student Progress" evaluation form is completed by the student with his/her advisor and submitted to the Director of Graduate Programs (DGP)
- An overall grade point average of at least 3.00 on graduate course work at NCSU is required

Faculty

Full Professors

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Adjunct Faculty

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Scott Harold Shore

Daniel van der Lelie

Microbiology (MS)

Degree Requirements

Students may choose from the Microbiology course tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Microbiology" without focus area track specifications.

Code	Title	Hours	Counts towards
Core Courses		**11**	
MB 601	Seminar		
MB 670	Laboratory Research Methods		
MB 686	Teaching Experience		
MB 590	Topical Problems (Professional Development)		
MB 695	Master's Thesis Research (6 credits minimum)		
Microbiology Courses		**6**	
See "Microbiology Courses" listed below			
Professional Development course		**1**	
"Professional Development Course" is determined in conjunction with the academic committee			
Elective Courses		**12**	
See "Elective Courses" listed below			
Total Hours		**30**	

Microbiology Courses

The field of Microbiology includes several specialized disciplines such as bacterial physiology, microbial genomics and metagenomics, microbiomes, environmental microbiology, immunology, host-pathogen interactions, molecular genetics and virology. At NC State, M.S. students can take courses that represent, and focus on, the various disciplines of

Microbiology. Example courses, fitting into two microbiology “tracks” or focus areas are:

Code	Title	Hours	Counts towards
Environmental / Industrial Track			
MB 520	Fundamentals of Microbial Cell Biotransformations	2	
MB 532	Soil Microbiology	4	
MB 555	Microbial Biotechnology	3	
MB 590	Topical Problems	1-3	
MB 505	Food Microbiology	3	
MB 714	Microbial Metabolic Regulation	3	
MB 725	Fermentation Microbiology	3	
MB 758	Microbial Genetics & Genomics	3	
Host-Pathogen Interactions Track			
MB 535	Bacterial Pathogenesis	3	
MB 718	Introductory Virology	3	
MB 751	Immunology	3	
BCH 553	Biochemistry of Gene Expression	3	
BCH 705	Molecular Biology Of the Cell	3	
BMA 771/772	Biomathematics I	3	
CBS 712	Reproductive Management and Disease in Domestic Animals	1	
ENT 582	Medical and Veterinary Entomology	3	
PP 707	Plant Microbe Interactions	3	
ST 511/512	Statistical Methods For Researchers I	3	

Elective Courses

Selection of elective courses is done by the student, in consultation with and approval by the advisory committee.

Code	Title	Hours	Counts towards
Below are examples of elective courses available:			
BAE 525	Industrial Microbiology and Bioprocessing	3	
BCH 553	Biochemistry of Gene Expression	3	
BCH 701	Macromolecular Structure	3	
BCH 703	Macromolecular Synthesis and Regulation	3	
BCH 705	Molecular Biology Of the Cell	3	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 595	Special Topics	1-6	
GN 701	Molecular Genetics	3	
GN 735	Functional Genomics	3	
GN 850	Professionalism and Ethics	1	
MB/PP 730	Fungal Genetics and Physiology	3	
MB 610	Special Topics Microbiology	1-6	
MB 620	Special Problems	1-6	
MB 601/801	Seminar	1	
MB 690/890	Master's Examination	1-9	
MB 695/895	Master's Thesis Research	1-9	
MB/IMM 783	Advanced Immunology	3	
MB 790	Topical Problems (Practical Digital Imaging)	1-3	

Additional Requirements

- 18 credits must be graded
- All graduate students must maintain a minimum cumulative grade point average of 3.0
- The program is completed upon submission of a thesis and completion of all credit requirements

Faculty

Full Professors

Prema Arasu

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Frederick Breidt

Dennis T. Brown

Jose Manuel Bruno-Barcena

Susan B. Carson

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Daniel van der Lelie

Microbiology (PhD)

Degree Requirements

Students may choose from the Microbiology course tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Microbiology" without focus area track specifications.

Code	Title	Hours	Counts towards
Core Courses		**10**	
MB 801	Seminar		
MB 870	Doctoral Lab Rotations		
MB 886	Teaching Experience		
MB 895	Doctoral Dissertation Research		
Microbiology Courses		**12**	
See "Microbiology Courses" listed below			
Professional Development course		**1**	
"Professional Development Course" is determined in conjunction with the academic committee			
Elective Courses		**49**	
See "Elective Courses" listed below			
Total Hours		**72**	

Microbiology Courses

For the Ph.D., 12 MB graded graduate credits must be taken. These courses can be chosen for breadth in microbiology or may focus on a sub-discipline of microbiology. Example courses fitting into two microbiology “tracks” or focus areas are:

Code	Title	Hours	Counts towards
Environmental / Industrial Track			
MB 520	Fundamentals of Microbial Cell Biotransformations	2	
MB 532	Soil Microbiology	4	
MB 555	Microbial Biotechnology	3	
MB 590	Topical Problems	1-3	
MB 505	Food Microbiology	3	
MB 714	Microbial Metabolic Regulation	3	
MB 725	Fermentation Microbiology	3	
MB 758	Microbial Genetics & Genomics	3	
Host-Pathogen Interactions Track			
MB 535	Bacterial Pathogenesis	3	
MB 718	Introductory Virology	3	
MB 751	Immunology	3	
BCH 553	Biochemistry of Gene Expression	3	
BCH 705	Molecular Biology Of the Cell	3	
BMA 771/772	Biomathematics I	3	
CBS 712	Reproductive Management and Disease in Domestic Animals	1	
ENT 582	Medical and Veterinary Entomology	3	
PP 707	Plant Microbe Interactions	3	
ST 511/512	Statistical Methods For Researchers I	3	

Elective Courses

Selection of elective courses is done by the student, in consultation with and approval by the advisory committee.

Code	Title	Hours	Counts towards
Below are examples of elective courses available:			
BAE 525	Industrial Microbiology and Bioprocessing	3	
BCH 553	Biochemistry of Gene Expression	3	
BCH 701	Macromolecular Structure	3	
BCH 703	Macromolecular Synthesis and Regulation	3	
BCH 705	Molecular Biology Of the Cell	3	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 595	Special Topics	1-6	
GN 701	Molecular Genetics	3	
GN 735	Functional Genomics	3	
GN 850	Professionalism and Ethics	1	

MB/PP 730	Fungal Genetics and Physiology	3
MB 610	Special Topics Microbiology	1-6
MB 620	Special Problems	1-6
MB 601/801	Seminar	1
MB 690/890	Master's Examination	1-9
MB 695/895	Master's Thesis Research	1-9
MB/IMM 783	Advanced Immunology	3
MB 790	Topical Problems (Practical Digital Imaging)	1-3

Additional Requirements

- 12 MB credits must be graded
- All graduate students must maintain a minimum cumulative grade point average of 3.0

Faculty

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Frederick Breidt

Dennis T. Brown

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Hosni Moustafa Hassan

Christine Veronica Hawkes

Shuijin Hu

Michael Hyman

Lee-Ann Jaykus

Sophia Kathariou

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Wei-Chen Chang

Nathan Crook

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Ryan William Paerl

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Leo W. Parks

Jason C. Shih

Adjunct Faculty

James M. Ligon

Maria Andrea Azcarate Peril

Scott Harold Shore

Daniel van der Lelie

Microbiology (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Microbiology Courses		**6**	
"Microbiology Courses" are approved in conjunction with the academic committee to meet the 6 total hours			
Total Hours		**6**	

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Nutrition

The Interdepartmental Nutrition Program consists of faculty from multiple departments, including: Animal Science; Agricultural and Human Sciences; Food, Bioprocessing, and Nutrition Sciences; Horticultural Science; Molecular and Structural Biochemistry; and the Prestage Department of Poultry Science. Students reside and conduct research in one of these departments under the direction of an appropriate advisor. Research in the nutrition program may be conducted with a variety of species and at various levels, such as molecular, cell, whole animal, and human communities. Research programs are primarily in the area of nutritional biochemistry, experimental animal nutrition (e.g. horses, ruminants, swine, poultry, rodents, and other species), or community nutrition and public health. Graduates find employment in academia, government, industry, and non-profit organizations, or continue their education in medical and allied health fields.

Admission Requirement

To be considered for admission, a student should have a B.S. or M.S degree, preferably in a science-related area. Additionally, applicants must have course work in biology and organic chemistry to be considered for admission. Students for M.S. or Ph.D. should contact and be recommended by a prospective major faculty advisor in their area of interest prior to final admission. Applicants to the Master of Nutrition should indicate their preferences for: on-campus or Distance Education delivery; an emphasis in animal, poultry, or food science (human) nutrition; core science or Professional Science Masters (PSM); and within the PSM, Feed Science or Human Nutrition.

Master's Degree Requirements

A minimum of 30 course credit hours, including a thesis is required for M.S., 36 for Master of Nutrition. The Master of Nutrition has options for all course delivery by Distance Education, with emphases in Feed Science or Human Nutrition, and an option for course work that qualifies as a Professional Science Master's degree.

Doctoral Degree Requirements

A minimum of 72 credit hours, including a dissertation for Ph.D. Students must complete core courses, including: Energy Metabolism, Protein and Amino Acid Metabolism, Vitamin Metabolism, and Mineral Metabolism.

Student Financial Support

Assistantships and fellowships may be available for M.S. and Ph.D. students on a competitive basis from the departments in which the advisor resides. Admission does not guarantee availability of financial support.

Degrees

- Nutrition (MR) (p. 178)
- Nutrition (MS) (p. 181)
- Nutrition (PhD) (p. 183)
- Nutrition (Minor) (p. 186)

Faculty

Full Professors

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Kenneth E Anderson
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Muquarrab Ahmed Qureshi

Nutrition (MR)

Master's Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**7**	
BCH 451	Principles of Biochemistry		
or NTR 501	Advanced Nutrition and Metabolism		
BCH 453/553	Biochemistry of Gene Expression		
or BCH 571	Regulation of Metabolism		
NTR 601	Master's Seminar		
Master's Core Courses		**8**	
Select a minimum of eight credits from "Core Courses" listed below			
Practicum Course		**4-6**	
Select one of the following courses:			
FM 594	Advanced Feed Mill Practicum		
NTR 624	Topical Problems In Nutrition		
NTR 693	Master's Supervised Research		
Elective Courses		**15-17**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic advisor			
Total Hours [1]		**36**	

[1] No more than 6 credit hours can be taken at the 400-level.

Core Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses from the following:		**8**	
BCH 553	Biochemistry of Gene Expression	3	
BCH 571	Regulation of Metabolism	3	
NTR 500	Principles of Human Nutrition	3	
NTR 501	Advanced Nutrition and Metabolism	3	
NTR 510	Maternal and Infant Nutrition	3	
NTR 515	Comparative Nutrition	3	
NTR 521	Life Cycle Nutrition	3	
NTR 525	Feed Manufacturing Technology	3	
NTR 550	Applied Ruminant Nutrition	3	
NTR 554	Lactation, Milk, and Nutrition	3	
NTR 555	Exercise Nutrition	3	
NTR 557	Nutraceuticals and Functional Foods	3	
NTR 561	Equine Nutrition	3	
NTR 565	Advanced Canine and Feline Nutrition	3	
NTR 594	Special Topics in Nutrition	1-6	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 764	Advances in Gastrointestinal Pathophysiology	3	
NTR 775	Mineral Metabolism	3	

NTR 785	Digestion and Metabolism in Ruminants	3
NTR 790	Advanced Feed Formulation	3
NTR 794	Special Topics in Nutrition	1-6

Professional Science Master's Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
BCH 451	Principles of Biochemistry		
or NTR 501	Advanced Nutrition and Metabolism		
BCH 453/553	Biochemistry of Gene Expression		
or BCH 571	Regulation of Metabolism		
Core Courses		**8**	
Select a minimum of eight credits from "Core Courses" listed below			
Seminar Course		**1**	
NTR 601	Master's Seminar		
Practicum Course		**4-6**	
Select one of the following courses:			
FM 594	Advanced Feed Mill Practicum		
NTR 624	Topical Problems In Nutrition		
NTR 693	Master's Supervised Research		
PSM Courses		**9**	
Select at least three courses from "PSM Courses" listed below			
Elective Courses		**6-8**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic advisor			
Total Hours [1]		**36**	

[1] No more than 6 credit hours can be taken at the 400-level.

Core Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses from the following:		**8**	
BCH 553	Biochemistry of Gene Expression	3	
BCH 571	Regulation of Metabolism	3	
NTR 500	Principles of Human Nutrition	3	
NTR 501	Advanced Nutrition and Metabolism	3	
NTR 510	Maternal and Infant Nutrition	3	
NTR 515	Comparative Nutrition	3	
NTR 521	Life Cycle Nutrition	3	
NTR 525	Feed Manufacturing Technology	3	
NTR 550	Applied Ruminant Nutrition	3	
NTR 554	Lactation, Milk, and Nutrition	3	
NTR 555	Exercise Nutrition	3	
NTR 557	Nutraceuticals and Functional Foods	3	
NTR 561	Equine Nutrition	3	
NTR 565	Advanced Canine and Feline Nutrition	3	
NTR 594	Special Topics in Nutrition	1-6	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 764	Advances in Gastrointestinal Pathophysiology	3	
NTR 775	Mineral Metabolism	3	
NTR 785	Digestion and Metabolism in Ruminants	3	
NTR 790	Advanced Feed Formulation	3	
NTR 794	Special Topics in Nutrition	1-6	

PSM Courses

Code	Title	Hours	Counts towards
Select at least three of the following courses: [1]		**9**	
FS 535	Food Safety Management Systems	3	
FS 553	Food Laws and Regulations	3	

COM 521	Communication and Globalization	3
COM 525	Group/Team Communication	3
COM 527	Seminar in Organizational Conflict Management	3
COM 530	Interpersonal Communication in Science and Technology Organizations	3
BUS 501	Strategic Management Foundations	3
BUS 590	Special Topics In Business Management	1-6
MBA 541	Supply Management	3
MBA 542	Supply Chain Logistics	3
MBA 543	Planning and Control Systems	3
MBA 576	Technology Entrepreneurship and Commercialization I	3
MBA 577	Technology Entrepreneurship and Commercializatior II	3

[1] The "PSM Courses" list is not an exclusive list.
Students can take any number of courses that relate to business, communication, or regulatory matters determined in conjunction with the academic committee.

Faculty

Full Professors

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Kenneth E Anderson
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Harold E. Swaisgood

Van-Den Truong

Lon Weidner Whitlow

Adjunct professors

Katherine Patterson Maloney

Muquarrab Ahmed Qureshi

Nutrition (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**7**	
BCH 451	Principles of Biochemistry		
or NTR 501	Advanced Nutrition and Metabolism		
BCH 453/553	Biochemistry of Gene Expression		
or BCH 571	Regulation of Metabolism		
NTR 601	Master's Seminar		
Master of Science Core Courses		**8**	
Select at least eight credits from "Core Courses" listed below			
Elective Courses		**15**	
"Elective Courses" that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee			
Thesis		**1-6**	
NTR 695	Master's Thesis Research		
Total Hours [1]		**30**	

[1] No more than 6 credit hours can be taken at the 400-level.

Core Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses from the following:		**8**	

BCH 553	Biochemistry of Gene Expression	3
BCH 571	Regulation of Metabolism	3
NTR 500	Principles of Human Nutrition	3
NTR 501	Advanced Nutrition and Metabolism	3
NTR 510	Maternal and Infant Nutrition	3
NTR 515	Comparative Nutrition	3
NTR 521	Life Cycle Nutrition	3
NTR 525	Feed Manufacturing Technology	3
NTR 550	Applied Ruminant Nutrition	3
NTR 554	Lactation, Milk, and Nutrition	3
NTR 555	Exercise Nutrition	3
NTR 557	Nutraceuticals and Functional Foods	3
NTR 561	Equine Nutrition	3
NTR 565	Advanced Canine and Feline Nutrition	3
NTR 594	Special Topics in Nutrition	1-6
NTR 701	Protein and Amino Acid Metabolism	3
NTR 706	Vitamin Metabolism	3
NTR 708	Energy Metabolism	3
NTR 764	Advances in Gastrointestinal Pathophysiology	3
NTR 775	Mineral Metabolism	3
NTR 785	Digestion and Metabolism in Ruminants	3
NTR 790	Advanced Feed Formulation	3
NTR 794	Special Topics in Nutrition	1-6

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Muquarrab Ahmed Qureshi

Nutrition (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**16**	
BCH 553	Biochemistry of Gene Expression		
or BCH 571	Regulation of Metabolism		
NTR 701	Protein and Amino Acid Metabolism		
NTR 706	Vitamin Metabolism		
NTR 708	Energy Metabolism		
NTR 775	Mineral Metabolism		
NTR 801	Doctoral Seminar		
Non-NTR 700-level Course		**3**	
The "Non-NTR 700-level Course" will be determined in conjunction with the academic committee			

PhD Core Courses		**5**
Select at least two courses from "Core Courses" listed below		
Doctoral Dissertation Research		**1-9**
NTR 895	Doctoral Dissertation Research	
Elective Courses		**39-47**
"Elective Courses" that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee		
Total Hours		**72**

Core Courses

Code	Title	Hours	Counts towards
Select at least two courses from the following:		**5**	
BCH 453/553	Biochemistry of Gene Expression	3	
BCH 571	Regulation of Metabolism	3	
NTR 500	Principles of Human Nutrition	3	
NTR 501	Advanced Nutrition and Metabolism	3	
NTR 510	Maternal and Infant Nutrition	3	
NTR 515	Comparative Nutrition	3	
NTR 521	Life Cycle Nutrition	3	
NTR 525	Feed Manufacturing Technology	3	
NTR 550	Applied Ruminant Nutrition	3	
NTR 554	Lactation, Milk, and Nutrition	3	
NTR 555	Exercise Nutrition	3	
NTR 557	Nutraceuticals and Functional Foods	3	
NTR 561	Equine Nutrition	3	
NTR 565	Advanced Canine and Feline Nutrition	3	
NTR 594	Special Topics in Nutrition	1-6	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 764	Advances in Gastrointestinal Pathophysiology	3	
NTR 775	Mineral Metabolism	3	
NTR 785	Digestion and Metabolism in Ruminants	3	
NTR 790	Advanced Feed Formulation	3	
NTR 794	Special Topics in Nutrition	1-6	

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Area of Research: Animal Science

Associate Professors

Dara Bloom
Area of Research: Agriculture and Human Sciences

April Fogleman
Area of Research: Food, Bioprocessing and Nutrition Science

Suzie Goodell
Area of Research: Food, Bioprocessing and Nutrition Science

Gabriel Keith Harris
Area of Research: Food, Bioprocessing and Nutrition Science

Lindsey Haynes-Maslow
Area of Research: Agriculture and Human Sciences

Collin Kay
Area of Research: Food, Bioprocessing and Nutrition Science

Slavko Komarnytsky
Area of Research: Food, Bioprocessing and Nutrition Science

Andrew Neilson
Area of Research: Food, Bioprocessing and Nutrition Science

Giuseppe Valachhi
Area of Research: Animal Science

Assistant Professors

Kimberly Ange-VanHeugten
Area of Research: Animal Science

Natalie Cooke
Area of Research: Food, Bioprocessing and Nutrition Science

Kerim Eroglu
Area of Research: Molecular and Structural Biochemistry

Massimo Iorizzo
Area of Research: Horticultural Science

Michael V. Joseph
Area of Research: Animal Science

Arion Kennedy
Area of Research: Molecular and Structural Biochemistry

Arion Kennedy Midgett
Area of Research: Molecular and Structural Biochemistry

Carrie Pickworth
Area of Research: Animal Science

Ondulla Toomer
Area of Research: Food, Bioprocessing and Nutrition Science - USDA

Nicola Singletary
Area of Research: Food, Bioprocessing and Nutrition Science

Emeritus Faculty

Brenda P Alston-Mills

Sarah Liberman Ash

Leonard W. Aurand

Leon Carl Boyd

Leonard S Bull

Edward V. Caruolo

George L. Catignani

Warren J Croom Jr

Jimmy Dale Garlich

Winston Murry Hagler

Raymond W. Harvey

William L Johnson

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James Arthur Knopp

Carolyn Jean Lackey

Jean-Marie Luginbuhl

Jacquelyn W. McClelland

Steven J. Schwartz

Jason C. Shih

Harold E. Swaisgood

Van-Den Truong

Lon Weidner Whitlow

Adjunct professors

Katherine Patterson Maloney

Muquarrab Ahmed Qureshi

Nutrition (Minor)

Master of Science Minor Plan Requirements

Code	Title	Hours	Counts towards
Master's Core Courses *		**8**	
Select at least three courses from "Master's Core Courses" listed below			
Total Hours		**8**	

Master's Core Courses

Code	Title	Hours	Counts towards
Select at least three courses from the following: *		**8**	
BCH 453/553	Biochemistry of Gene Expression	3	
BCH 571	Regulation of Metabolism	3	
NTR 500	Principles of Human Nutrition	3	
NTR 401/501	Advanced Nutrition and Metabolism	3	
NTR 410/410	Maternal and Infant Nutrition	3	
NTR 415/415	Comparative Nutrition	3	
NTR 419	Human Nutrition and Chronic Disease	3	
NTR 420	Applied Nutrition Education	3	
NTR 421/521	Life Cycle Nutrition	3	
NTR 425/525	Feed Manufacturing Technology	3	
NTR 550	Applied Ruminant Nutrition	3	
NTR 554	Lactation, Milk, and Nutrition	3	
NTR 555	Exercise Nutrition	3	
NTR 557	Nutraceuticals and Functional Foods	3	
NTR 561	Equine Nutrition	3	
NTR 565	Advanced Canine and Feline Nutrition	3	
NTR 594	Special Topics in Nutrition	1-6	
NTR 701	Protein and Amino Acid Metabolism	3	
NTR 706	Vitamin Metabolism	3	
NTR 708	Energy Metabolism	3	
NTR 764	Advances in Gastrointestinal Pathophysiology	3	
NTR 775	Mineral Metabolism	3	
NTR 785	Digestion and Metabolism in Ruminants	3	
NTR 790	Advanced Feed Formulation	3	
NTR 794	Special Topics in Nutrition	1-6	

* No more than three hours of 400-level coursework can be applied toward the 8 total hours

Doctor of Philosophy Minor

Code	Title	Hours	Counts towards
Required Courses		**4**	
BCH 553	Biochemistry of Gene Expression		
or BCH 571	Regulation of Metabolism		
NTR 801	Doctoral Seminar		
Non-NTR 700-level Course		**3**	
The "Non-NTR 700-level Course" will will be determined in conjunction with the academic committee			
PhD Core Courses		**8**	
Select at least two courses from "PhD Core Courses" listed below			
Total Hours		**15**	

PhD Core Courses

Code	Title	Hours	Counts towards
Select at least three courses from the following:			
BCH 553	Biochemistry of Gene Expression	3	
BCH 571	Regulation of Metabolism	3	
NTR 500	Principles of Human Nutrition	3	
NTR 501	Advanced Nutrition and Metabolism	3	
NTR 510	Maternal and Infant Nutrition	3	
NTR 515	Comparative Nutrition	3	
NTR 521	Life Cycle Nutrition	3	

NTR 525	Feed Manufacturing Technology	3
NTR 550	Applied Ruminant Nutrition	3
NTR 554	Lactation, Milk, and Nutrition	3
NTR 555	Exercise Nutrition	3
NTR 557	Nutraceuticals and Functional Foods	3
NTR 561	Equine Nutrition	3
NTR 565	Advanced Canine and Feline Nutrition	3
NTR 594	Special Topics in Nutrition	1-6
NTR 701	Protein and Amino Acid Metabolism	3
NTR 706	Vitamin Metabolism	3
NTR 708	Energy Metabolism	3
NTR 764	Advances in Gastrointestinal Pathophysiology	3
NTR 775	Mineral Metabolism	3
NTR 785	Digestion and Metabolism in Ruminants	3
NTR 790	Advanced Feed Formulation	3
NTR 794	Special Topics in Nutrition	1-6

Faculty

Full Professors

Jonathan C. Allen
Area of Research: Food, Bioprocessing and Nutrition Science

Kenneth E Anderson
Area of Research: Prestige Poultry Science

Patricia C. Dunn
Area of Research: Agriculture and Human Sciences

Joan Eisemann
Area of Research: Animal Science

Vivek Fellner
Area of Research: Animal Science

Peter R. Ferket
Area of Research: Prestige Poultry Science

Mario Ferruzzi
Area of Research: Food, Bioprocessing and Nutrition Science

Jesse Lee Grimes
Area of Research: Prestige Poultry Science

Sung Woo Kim
Area of Research: Animal Science

Mary Ann Lila
Area of Research: Food, Bioprocessing and Nutrition Science

Christian Maltecca
Area of Research: Animal Science

Jeannette A. Moore
Area of Research: Animal Science

Paul Edward Mozdziak
Area of Research: Prestige Poultry Science

Jack Odle
Area of Research: Animal Science

Edgar Orlando Oviedo-Rondon
Area of Research: Prestige Poultry Science

Shannon Elizabeth Phillips
Area of Research: Animal Science

Matt H. Poore
Area of Research: Animal Science

Muquarrab Quresh
Area of Research: Food, Bioprocessing and Nutrition Science - USDA

Paul David Siciliano
Area of Research: Animal Science

Eric VanHeugten
Area of Research: Animal Science

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Harold E. Swaisgood

Van-Den Truong

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Physiology

The Physiology Graduate Program is an interdisciplinary and interdepartmental program comprising faculty drawn from across the University. An advanced degree in Physiology is highly valued by the scientific community and can lead to careers in research and teaching in academia, industry and government laboratories, public policy and consulting. Research is carried out using a variety of model organisms, laboratory and companion and agriculturally important species.

Admission Requirements

Students entering the graduate program in Physiology should have a Bachelor's degree in a related biological or physical science. Undergraduate courses should include Physiology, Biochemistry, Organic Chemistry, Calculus, and Physics. Each application package will be screened by the Admissions Committee. Factors considered for admission include: grade point average (3.0 is required for regular admission), GRE scores, undergraduate courses, letters of recommendation, and the willingness of a member of the Graduate Physiology faculty to serve as the applicant's advisor.

Master's Degree Requirements

All Master's students are required to complete PHY 503, PHY 504, BCH 553, and a one-credit hour course in research ethics. Master of Science Degree: For a Master of Science degree a minimum of 30 semester hours of graduate work in the degree program is required including a minimum of 20 hours of course work at the 500-800 level. On average, the M.S. degree takes two to three years to complete. Master of Physiology Degree: The non-thesis Master's degree (Master of Physiology) requires a total of 36 credits. The median time to degree completion is 1.75 years or less.

Student Financial Support

Financial assistance for qualified students in the form of research assistantships, fellowships and traineeships is available through

participating departments only and not through the Physiology program for thesis-based students only.

Other Relevant Information

Graduate students enrolled as Physiology majors are housed in the department of their major professor and may participate in departmental activities.

Recommended Courses Normally Included in Programs of Study for the M.S Degree and the Non-Thesis MOP Program

Other recommended/supporting courses are available through many departments, e.g. Animal Science, Biochemistry, Biomathematics, Biotechnology, Cell Biology, Comparative Biomedical Sciences, Entomology, Genetics, Immunology, Microbiology, Nutrition, Pharmacology, Poultry Science, Psychology, Statistics, and Toxicology, and may be included for consideration in the plan of work.

Degrees

- Physiology (MR) (p. 190)
- Physiology (MS) (p. 191)
- Physiology (Minor) (p. 192)

Faculty

Full Professors

Glen William Almond

Kenneth E. Anderson

Christopher M. Ashwell

Betty L. Black

Anthony T. Blikslager

Russell J. Borski

Patricia Ann Curtis

David C. Dorman

Frank W. Edens

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Marianne Niedzlek-Feaver

Marcelo Rodriguez-Puebla

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Hanna Gracz

Jeong Dae Lee

Jane L. Lubischer

Shweta Trivedi

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Harold F. Heatwole

Thomas E. Levere

John F. Roberts

Malcolm C. Roberts

Thomas David Siopes

Herbert A. Underwood

Steven Paul Washburn

Michael David Whitacre

Thomas G. Wolcott

Physiology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
PHY 503	General Physiology I		
PHY 504	General Physiology II		
BCH 553	Biochemistry of Gene Expression		
Ethics in Research Course		**1**	
Select one of the following courses:			
BIT 501	Ethical Issues in Biotechnology		
CBS 662	Professional Conduct in Biomedical Research		
PHI 816	Introduction to Research Ethics		
Elective Courses		**26**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee			
Total Hours		**36**	

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Thomas G. Wolcott

Physiology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
PHY 503	General Physiology I		
PHY 504	General Physiology II		
BCH 553	Biochemistry of Gene Expression		
Ethics in Research Course		**1**	
Select one of the following courses:			
BIT 501	Ethical Issues in Biotechnology		
CBS 662	Professional Conduct in Biomedical Research		
PHI 816	Introduction to Research Ethics		
Elective Courses		**26**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee			
Total Hours		**36**	

Faculty

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Thomas G. Wolcott

Physiology (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
PHY 503	General Physiology I		
PHY 504	General Physiology II		
BCH 553	Biochemistry of Gene Expression		
Additional Course		**3**	
Students may choose "Additional Course" from a department outside Physiology approved in conjunction with the academic committee			
Total Hours		**12**	

Additional Requirements

Minor representative must be from the Physiology Faculty and the representative must be identified before the preliminary exam and the Minor representative must participate in the preliminary examination (as well as the final examination).

Faculty

Full Professors

Glen William Almond

Kenneth E. Anderson

Christopher M. Ashwell

Betty L. Black

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Patricia Ann Curtis

David C. Dorman

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Thomas David Siopes

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Steven Paul Washburn

Michael David Whitacre

Thomas G. Wolcott

Plant Biology

Course offerings in diverse areas of plant biology, ranging from the molecular to the ecosystem scale. Research opportunities and facilities are available in the following areas: cell biology, cellular imaging, cellulose biology, cellular signaling, developmental biology, plant hormones, epigenetics, systems biology, genetic engineering, transgene regulation and silencing, stress biology, plant gravitropism, phytochemistry, metabolic engineering, plant-microbe interactions, aquatic ecology, toxic dinoflagellates, endangered species, community ecology, physiological ecology, tropical ecology, evolutionary ecology, population ecology, paleobotany, plant systematics, evolution of flowering plants, and ethnobotany.

Admission Requirements

Students entering the graduate program in plant biology should have a bachelor's degree in plant biology or a related undergraduate program that includes biological, physical and mathematical science training including undergraduate courses in organic chemistry, calculus and genetics, as well as biology. All applications are screened by a departmental committee, and the best qualified applicants will be accepted until all available spaces are filled.

Master's and Doctoral Degree Requirements

The M.S. requires a total of 30 credit hours (20 of the 30 credit hours must be from 500-, 600-, 700/800-level courses; 18 credit hours must be letter graded); the Master of Plant Biology requires a total of 36 credit hours. The Ph.D. requires a total of 72 credit hours. Two core courses (Functional Plant Biology and either Plant Functional Ecology or Systematic Botany) are required. Other requirements include: a Plant Biology Colloquium, Plant Anatomy, an additional plant biology course, a graduate statistics course, a graduate ethics course, a thesis (for the M.S., but not the Master of Plant Biology) or dissertation (for the PhD), written and oral preliminary examinations (Ph.D.), oral thesis or dissertation defense, and a one (M.S.) or two semester (Ph.D.) teaching experience. Students must maintain a "B" average in all course work.

Other Relevant Information

Graduate research and teaching assistantships and tuition remission information are available from the department. New students supported by departmental research/teaching assistantships may elect to rotate through three laboratories during their first semester. At the end of the semester, they will choose a laboratory for their research activities consistent with their interests and available research projects. Cooperative research in more than one laboratory is encouraged. Graduate students are expected to attend and participate in the seminar program every semester they are in residence. The department participates in training grants in biotechnology.

Degrees

- Plant Biology (MR) (p. 194)
- Plant Biology (MS) (p. 196)
- Plant Biology (PhD) (p. 197)
- Plant Biology (Minor) (p. 198)

Associate professors

Jose Miguel Alonso

Richard L. Blanton

Kent Oliver Burkey

Joann M. Burkholder

Susan B. Carson

Ralph E. Dewey

Robert Graham Franks

Amy Michele Grunden

Candace Hope Haigler

Linda Kay Hanley-Bowdoin

Christine Veronica Hawkes

William A. Hoffmann

Shuijin Hu

James E. Mickle

Thomas W. Rufty Jr.

Jean B. Ristaino

Heike Inge Ada Sederoff

William F. Thompson

Ross W. Whetten

Qiuyun Xiang

Deyu Xie

Tzung Fu Hsieh

Slavko Komarnytsky

Alexander Krings

Xu Li

Terri A.Long

Marcela Pierce

Rosangela Sozzani

Anna N. Stepanova

Jillian Marie De Gezelle

Chad Victor Jordan

Imara Yasmin Perera

Carole H. Saravitz

Nina S. Allen

Udo Blum

Wendy F. Boss

Rebecca S. Boston

Margaret E. Daub

Roger C. Fites

James W. Hardin

Walter Webb Heck

Rongda Qu

Jon M. Stucky

Judith F. Thomas

C. Gerald VanDyke

Thomas R. Wentworth

Assistant professors

Orlando Arguello-Miranda

Colleen Jennifer Doherty

Manuel Kleiner

William Kevin Petry

Seema Nayan Sheth

Plant Biology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**16**	
PB 795	Special Topics Botany (Functional Plant Biology) [1]		
PB 513	Plant Anatomy [1]		
PB 570	Plant Functional Ecology [1]		
or PB 503	Systematic Botany		
PB 824	Topical Problems (Plant Biology Colloquium)		
ST 511	Statistical Methods For Researchers I [1]		
PHI 816	Introduction to Research Ethics (or equivalent ethics course)		
Plant Biology Course		**3**	
Select one PB prefix course [2]		3	
PB 685	Master's Supervised Teaching		

PB 693	Master's Supervised Research	
Additional Courses		**14**
Additional Courses are determined in conjunction with the academic committee to meet the 36 total hours		
Total Hours		**36**

1 The course must be taken for a letter grade.

2 "Plant Biology Course" is determined in conjunction with the academic committee

Additional Requirements

M.R. degree students complete the required courses and other courses for 36 total credit hours (at the 500 level or above); 18 hours must be letter-grade. They must also complete a project (and register for 6 hours of PB 693 related to the project) and pass a comprehensive oral exam on general plant biology.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Associate professors

Jose Miguel Alonso

Richard L. Blanton

Kent Oliver Burkey

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Colleen Jennifer Doherty

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Seema Nayan Sheth

Plant Biology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15-16**	
PB 795	Special Topics Botany (Functional Plant Biology) [1]		
PB 513	Plant Anatomy [1]		
PB 824	Topical Problems (Botany Colloquium)		
ST 511	Statistical Methods For Researchers I [1]		
PHI 816	Introduction to Research Ethics (or equivalent ethics course)		
PB 570	Plant Functional Ecology [1]		
or PB 503	Systematic Botany		
Teaching / Research Courses		**2-12**	
PB 685	Master's Supervised Teaching		
PB 693	Master's Supervised Research		
Plant Biology Course		**3**	
Select one PB prefix course [2]			
Additional Courses		**3-10**	
Additional Courses are determined in conjunction with the academic committee to meet the 30 total hours			
Total Hours		**30**	

1 The course must be taken for a letter grade.

2 "Plant Biology Course" is determined in conjunction with the academic committee

Additional Requirements

M.S. degree students complete the required courses and other courses for 30 total credit hours (at the 500 level or above); 18 hours must be letter-graded. They must also complete and defend a thesis.

Associate professors

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Seema Nayan Sheth

Plant Biology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15-16**	
PB 795	Special Topics Botany (Functional Plant Biology) [1]		
PB 513	Plant Anatomy [1]		
PB 824	Topical Problems (Botany Colloquium)		
ST 511	Statistical Methods For Researchers I [1]		
PHI 816	Introduction to Research Ethics (or equivalent ethics course)		
PB 570	Plant Functional Ecology [1]		
or PB 503	Systematic Botany		
Teaching / Research Courses		**2-12**	
PB 885	Doctoral Supervised Teaching		
PB 893	Doctoral Supervised Research		
Plant Biology Course		**3**	
Select one PB prefix course [2]			
Additional Courses		**41-52**	
Additional Courses are determined in conjunction with the academic committee to meet the 72 total hours			
Total Hours		**72**	

1. The course must be taken for a letter grade.
2. "Plant Biology Course" is determined in conjunction with the academic committee

Additional Requirements

Ph.D. degree students complete the required courses and other courses for 72 total credit hours (at the 500 level or above). They must also pass a written and oral preliminary exam, and defend a dissertation.

Associate professors

Jose Miguel Alonso

Richard L. Blanton

Kent Oliver Burkey

Joann M. Burkholder

Susan B. Carson

Ralph E. Dewey

Robert Graham Franks

Amy Michele Grunden

Candace Hope Haigler

Linda Kay Hanley-Bowdoin

Christine Veronica Hawkes

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Shuijin Hu

James E. Mickle

Thomas W. Rufty Jr.

Jean B. Ristaino

Heike Inge Ada Sederoff

William F. Thompson

Ross W. Whetten

Qiuyun Xiang

Deyu Xie

Tzung Fu Hsieh

Slavko Komarnytsky

Alexander Krings

Xu Li

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Rosangela Sozzani

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Udo Blum

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Roger C. Fites

James W. Hardin

Walter Webb Heck

Rongda Qu

Jon M. Stucky

Judith F. Thomas

C. Gerald VanDyke

Thomas R. Wentworth

Assistant professors

Orlando Arguello-Miranda

Colleen Jennifer Doherty

Manuel Kleiner

William Kevin Petry

Seema Nayan Sheth

Plant Biology (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
PB 795	Special Topics Botany (Functional Plant Biology)		
PB 570	Plant Functional Ecology		
or PB 503	Systematic Botany		
Plant Biology Courses		**6**	
"Plant Biology Courses" are determined in conjunction with the academic committee *			
Total Hours		**12**	

* "Plant Biology Courses" must be above the 500-level with a grade of a B or above

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Plant Pathology

Plant pathology researches and extends knowledge to solve plant disease problems by focusing on plant-pathogen interactions at the genomic, cellular, organismal, and ecological levels. Approaches include disease management, epidemiology, molecular biology and host-parasite interactions. Focus areas are bacteriology, bioinfomatics, functional genomics, mycology, nematology, virology, soil-borne pathogens and mechanisms of pathogenesis, and host resistance.

Admission Requirements

The general application procedures of the Graduate School noted at the beginning of this section are followed. The Plant Pathology Graduate Program does NOT require the GRE. A detailed statement of applicant interests and goals in plant pathology is very helpful for the admissions committee.

Master's Degree Requirements

There is a core curriculum of a minimum of 12 credit hours that includes PP 501, PP 502, PP 506, PP 707, and PP 601. The core should be supplemented with a minimum of 18 credit hours in courses at the 500 or higher level, which support the focus of the study. Students serve as teaching assistants for one course.

Doctoral Degree Requirements

Students entering the Ph.D. degree program are expected to take the core curriculum outlined for the Master's degree or have had the equivalent at another institution. Additionally, Ph.D. students must include a departmental-approved ethics course, two credits PP 801, and at least two other 700-level Plant Pathology courses. Ph.D. students serve as teaching assistants for two courses.

Student Financial Support

A limited number of half-time assistantships are available on a competitive basis. Benefits include in-state tuition, out-of-state tuition and health insurance as covered under the Graduate School's Graduate Student Support Plan. Applicants are considered for assistantship support at time of application. Special supplements to assistantships are available on a competitive basis for outstanding students. Also, many faculty programs have research grant-funded or training grant-funded assistantships. Contact individual faculty regarding availability of research assistantships.

Other Relevant Information

Fully equipped and staffed laboratories for research are available in addition to greenhouse facilities and environmental growth chambers in the phytotron. Special facilities for experimental work on diseases under field conditions are available at 16 University and NC Department of Agriculture and Consumer Services-related locations throughout the state. Genomics facilities, microcomputers, library, mycological herbarium, digital imaging/graphics equipment programs, and an interdepartmental electron microscopy center are additional features available for the department.

Degrees

- Plant Pathology (MR) (p. 200)
- Plant Pathology (MS) (p. 202)
- Plant Pathology (PhD) (p. 203)
- Plant Pathology (Minor) (p. 204)

Faculty

Full Professors

Peter J. Balint-Kurti

David M. Bird

Ignazio Carbone

Christina Cowger

Marc A. Cubeta

Eric Lee Davis

Ralph A. Dean

Shuijin Hu

Steven Lommel

Frank John Louws

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Sara Michelle Villani

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Turner Bond Sutton

Hedwig Hirschm Triantaphyllou

Robert G. Upchurch

Adjunct Faculty

Tim Sit

Lindsey Danielle Thiessen

Plant Pathology (MR)

Master of Plant Pathology Degree Requirements

Code	Title	Hours	Counts towards
Core Curriculum		**12**	
PP 501	Biology of Plant Pathogens		
PP 502	Plant Disease: Methods & Diagnosis		
PP 506	Epidemiology and Plant Disease Control		

PP 707	Plant Microbe Interactions	
PHI 816	Introduction to Research Ethics (or equivalent research ethics course)	
Additional Requirements		**6**
Select minimum of 6 credit hours graduate-level Plant Pathology courses approved in conjunction with the academic committee		
Elective Courses		**12**
"Elective Courses" will be determined in conjunction with the academic committee		
Total Hours		**30**

Faculty

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Plant Pathology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Curriculum		**12**	
PP 501	Biology of Plant Pathogens		
PP 502	Plant Disease: Methods & Diagnosis		
PP 506	Epidemiology and Plant Disease Control		
PP 707	Plant Microbe Interactions		
PHI 816	Introduction to Research Ethics (or equivalent research ethics course)		
Additional Requirements		**18**	
PP 601	Seminar		
PP 685	Master's Supervised Teaching (minimum 1 credit hour teaching)		
PP 695	Master's Thesis Research (maximum 6 credit hours thesis research)		
Select a minimum six credit hours graduate-level Plant Pathology courses approved in conjunction with the academic committee			
Total Hours		**30**	

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Plant Pathology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Curriculum		**12**	
PP 501	Biology of Plant Pathogens		
PP 502	Plant Disease: Methods & Diagnosis		
PP 506	Epidemiology and Plant Disease Control		
PP 707	Plant Microbe Interactions		
PHI 816	Introduction to Research Ethics (or equivalent research ethics course)		
Addtional Requirements		**60**	
PP 885	Doctoral Supervised Teaching (minimum 2 semesters teaching)		
Select a minimum 12 credit hours graduate-level Plant Pathology courses			
Select a minimum 6-12 credit hours 700-level or above Plant Pathology courses			
PP 801	Seminar In Plant Pathology (2 credit hours seminar)		
Total Hours		**72**	

Faculty

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Plant Pathology (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Poultry Science

Course offerings and research programs are comprehensive in the areas of physiology, nutrition, microbiology, molecular biology, biotechnology, food science, immunology, genetics, pathology, and toxicology. The demand for skilled workers with advanced training in poultry science is far greater than the supply. Opportunities exist for graduates in research and teaching in universities, government, and private industry.

Admission Requirements

Factors considered for admission include grade point average, strength of prior academic program, experience, letters of recommendation, and special skills or interests. GRE scores are recommended, but not required.

Master's Degree Requirements

While there are no specific course requirements for the master's degree in Poultry Science, most programs complete 36 credit hours.

Doctoral Degree Requirements

See Animal Science and Poultry Science.

Student Financial Support

Both research and teaching assistantships are available on a competitive basis within the department. General requirements for these assistantships are as described in the Graduate Catalog. Other financial support may be available in the form of graduate stipend supplementation, research grant support, or out-of-state tuition waivers in accordance with the University's Graduate Student Support Plan.

Other Relevant Information

The Department of Poultry Science occupies modern facilities in Scott Hall, a three-story building on the main campus adjacent to the D.H. Hill Library. The department consists of about 20 faculty, approximately 40 support staff, 25 graduate students and postdoctoral associates, and 100 undergraduate students.

Degrees

- Poultry Science (MR) (p. 206)
- Poultry Science (MS) (p. 209)
- Poultry Science (Minor) (p. 210)
- Feed Science (Certificate) (p. 211)

Faculty

Full Professors

Kenneth E. Anderson

Frank W. Edens

Peter R. Ferket

Jesse Lee Grimes

Hosni Moustafa Hassan

Aaron S. Keiss

Matthew D. Koci

Paul Edward Mozdziak

Edgar Orlando Oviedo-Rondon

James N. Petitte

Associate Professors

Mark T. Knauer

Assistant Professors

Chongxiao (Sean) Chen

Adam Charles Fahrenholz

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Mahmoud A. N. A. N. Sharara

Ondulla Tyvette Toomer

Lin Walker

Lin Li Walker

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Jason C. Shih

Thomas David Siopes

Charles Michael Williams

Adjunct Faculty

Andrea Villanes Arellano

Aaron Shawn Kiess

Rasha Qudsieh

Nelson E. Ward

Poultry Science (MR)

Master's Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**10**	
PO 601	Seminar		
PO 685	Master's Supervised Teaching		
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BCH 451	Principles of Biochemistry		
or BCH 553	Biochemistry of Gene Expression		
Elective Courses		**26**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee			
Students are encouraged to choose these courses from the "Graduate Elective Courses" listed below			
Total Hours		**36**	

Elective Courses

Code	Title	Hours	Counts towards
Students are encouraged to choose from the following courses:			
PO 504	Avian Anatomy and Physiology	4	
PO 506	Physiological Aspects of Poultry Management	3	
PO 510	Poultry Product Safety: An On-Farm Model	3	
PO 515	Comparative Nutrition	3	
PO 524	Comparative Endocrinology	3	
FM 525	Feed Manufacturing Technology	3	
PO 533	Poultry Processing and Products	3	

FM 580	Feed and Ingrdient Quality Assurance	3
PO 590	Special Problems in Poultry Science	1-6
FM 790	Advanced Feed Formulation	3
IMM 757	Comparative Immunology	3

Professional Science Master's Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**17**	
PO 601	Seminar		
PO 620	Special Problems		
PO 685	Master's Supervised Teaching		
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BCH 451	Principles of Biochemistry		
or BCH 553	Biochemistry of Gene Expression		
Professional Development (PLUS) Courses		**9-12**	
Select a minimum of three courses from "Professional Development (PLUS) Courses" listed below			
Elective Courses		**10-15**	
"Elective Courses" that will be applied to reach 36 credit hours will be determined in conjunction with the academic committee			
Students are encouraged to choose these courses from the "Graduate Elective Courses" listed below			
Total Hours		**36**	

Professional Development (PLUS) Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses below:		**9-12**	
BAE 578	Agricultural Waste Management	3	
ST 513	Statistics for Management and Social Sciences I	3	
BUS 420	Financial Management of Corporations	3	
BUS 460	Consumer Behavior	3	
BUS 461	Channel and Retail Marketing	3	
BUS 462	Marketing Research	3	
BUS 464	International Marketing	3	
BUS 465	Traditional and Digital Brand Promotion	3	
BUS 467	Product and Brand Management	3	
BUS 468	Marketing Strategy	3	
BUS 472	Operations Planning and Control Systems	3	
BUS 473	Supply Chain Strategy	3	
BUS 474	Logistics Management	3	
BUS 475	Purchasing and Supply Management	3	
BUS 501	Strategic Management Foundations	3	
BUS 590	Special Topics In Business Management	1-6	
BUS 610		1-6	
COM 521	Communication and Globalization	3	
COM 527	Seminar in Organizational Conflict Management	3	
COM 530	Interpersonal Communication in Science and Technology Organizations	3	
ST 751	Econometric Methods	3	
FM 460	Feed Mill Operations and Leadership	3	
MBA 521	Advanced Corporate Finance	3	
MBA 530	Leading People	3	
MBA 541	Supply Management	3	

MBA 542	Supply Chain Logistics	3
MBA 543	Planning and Control Systems	3
MBA 552	Data Engineering, Management and Warehousing	3
MBA 555	Product Design and Development	4
MBA 564	Business Relationship Management	3
MBA 576	Technology Entrepreneurship and Commercializatior I	3
MBA 586	Legal, Regulatory and Ethical Issues in Life Science Industries	3
MBA 577	Technology Entrepreneurship and Commercializatior II	3
MBA 610	Special Topics in Business Administration	1-6
PS 536	Global Environmental Law and Policy	3

Elective Courses

Code	Title	Hours	Counts towards
Students are encouraged to select from the courses below:			
PO 504	Avian Anatomy and Physiology	4	
PO 506	Physiological Aspects of Poultry Management	3	
PO 510	Poultry Product Safety: An On-Farm Model	3	
PO 515	Comparative Nutrition	3	
PO 524	Comparative Endocrinology	3	
FM 525	Feed Manufacturing Technology	3	
PO 533	Poultry Processing and Products	3	
FM 580	Feed and Ingrdient Quality Assurance	3	
PO 590	Special Problems in Poultry Science	1-6	
FM 790	Advanced Feed Formulation	3	
IMM 757	Comparative Immunology	3	

Faculty

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Poultry Science (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**10**	
PO 601	Seminar		
PO 685	Master's Supervised Teaching		
ST 511	Statistical Methods For Researchers I		
or ST 512	Statistical Methods For Researchers II		
BCH 451	Principles of Biochemistry		
or BCH 553	Biochemistry of Gene Expression		
Graduate Electives / Research Courses		**20**	
Select courses from "Elective Courses" and "Research Courses" listed below to reach 30 credit hours determined in conjunction with the academic committee			
Total Hours		**30**	

Elective Courses

Code	Title	Hours	Counts towards
Students are encouraged to choose from the following courses:			
PO 504	Avian Anatomy and Physiology	4	
PO 506	Physiological Aspects of Poultry Management	3	
PO 510	Poultry Product Safety: An On-Farm Model	3	
PO 515	Comparative Nutrition	3	
PO 524	Comparative Endocrinology	3	
FM 525	Feed Manufacturing Technology	3	
PO 533	Poultry Processing and Products	3	
FM 580	Feed and Ingrdient Quality Assurance	3	
PO 590	Special Problems in Poultry Science	1-6	
FM 790	Advanced Feed Formulation	3	
IMM 757	Comparative Immunology	3	

Research Courses

Code	Title	Hours	Counts towards
PO 693	Master's Supervised Research	1-9	
PO 695	Master's Thesis Research	1-9	
PO 699	Master's Thesis Preparation	1-9	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Poultry Science (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Poultry Science Graduate Courses

Code	Title	Hours	Counts towards
PO 504	Avian Anatomy and Physiology	4	
PO 506	Physiological Aspects of Poultry Management	3	
PO 510	Poultry Product Safety: An On-Farm Model	3	
PO 515	Comparative Nutrition	3	
PO 524	Comparative Endocrinology	3	
PO 525	Feed Manufacturing Technology	3	
PO 533	Poultry Processing and Products	3	
PO 566	Animal Cell Culture Techniques	2	

PO 580	Feed and Ingrdient Quality Assurance	3
PO 590	Special Problems in Poultry Science	1-6
PO 601	Seminar	1
PO 620	Special Problems	1-6
PO 757	Comparative Immunology	3
PO 775	Mineral Metabolism	3
PO 801	Graduate Seminar In Poultry Science	1
PO 820	Special Problems In Poultry Science	1-6

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Nelson E. Ward

Feed Science (Certificate)

The Graduate Certificate Program in Feed Science is designed to prepare professionals or current degree program students to work in or alongside the animal food industry. The program will provide an advanced foundation in feed science technology, quality assurance and feed formulation, and feed industry leadership. The objectives of this program are for the student to acquire an understanding of the technical aspects of modern animal food manufacturing; food and ingredient quality assurance; animal food safety; feed industry regulations; facility operations, leadership, and safety; formulation; and generally how to apply technical skills to the challenges of the global animal food industry.

Admission Requirements

Applicants must have a BS/BA degree or equivalent four year degree in order to apply to the program. Individuals interested in this certificate program must contact the coordinator of the certificate program.

Program Requirements

A minimum of 12 credit hours from the prescribed list of courses and a grade of 'C-' or better in these courses is required to receive credit for the certificate. To receive a Graduate Certificate in Feed Science, a student must have a minimum 3.0 grade point average on all certificate course work. All course work must be registered through NC State University, transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the application is approved by the Director of Graduate Programs.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
FM/ANS/NTR/PO 525	Feed Manufacturing Technology		
FM/PO 580	Feed and Ingrdient Quality Assurance		
PO/ANS/NTR 515	Comparative Nutrition		
Elective Courses			
Select a minimum of one of the following courses:		3	
FM 460/PO 590	Feed Mill Operations and Leadership		
FM 490	Feed Science Seminar		
FM 594	Advanced Feed Mill Practicum		
FM/NTR 790	Advanced Feed Formulation		
Total Hours		**12**	

Soil Science

Soil scientists study and manage land and water resources to protect the environment and enhance agricultural productivity. Graduate education opportunities in Soil Science at NC State prepare students for careers with public and private organizations in soil, agricultural, environmental, and natural resource sciences. Our graduates find employment opportunities with private sector firms, government organizations, academia, and entrepreneurship.

You will have the opportunity to study and do research with world-class faculty in outstanding laboratory and field facilities. Graduate students may specialize in the following sub-disciplines: soil physics; soil chemistry; soil microbiology and biochemistry; soil fertility and plant nutrition; soil genesis, morphology and classification; and soil, water and land management and conservation. Students can also incorporate other disciplines into their work, presenting outstanding opportunities to focus on issues of interest.

Graduate Degrees

The Department of Crop and Soil Sciences offers three graduate degrees in Soil Science. A short description of each follows.

The ***Master of Soil Science*** (the MR degree) is a non-thesis, course-based program that is available as both a campus-based and an online, distance education program (https://go.ncsu.edu/online-soil-science-masters/). This degree is considered a terminal degree and is well suited to professionals requiring further education in soils for their careers.

The ***Master of Science in Soil Science*** (MS) is a research degree that requires the successful completion of coursework, a research problem, and the submission of a written thesis that documents the research.

The ***Doctor of Philosophy*** (Ph.D.) degree symbolizes the ability of the student to undertake original research with minimal supervision and demonstrates the student's ability to write a dissertation reporting the results of this research. Most students in the Soil Science Ph.D. complete an MS degree prior to enrolling in the Ph.D., although exceptions are sometimes made.

Admission Requirements

A minimum of a 3.0 GPA at the baccalaureate (BS) or master's (MS) level is required. However, exceptions may be made for master's applicants with a very strong GPA in science classes, an exceptional track record in their final two years, or substantial post-baccalaureate work experience. Students accepted will typically have a BS or MS degree in Soil Science, or closely related fields, with strong preparation in the biological and physical sciences. Research experience is helpful. The Graduate Record Exam (GRE) is not required for application or admission to Soil Science graduate programs. International students must demonstrate proficiency in English prior to admission. Admissions are competitive and subject to adequate funding for research assistantships. A committee of faculty members evaluates each application and admission is offered if funding is available to support a student. Master of Soil Science applicants are admitted without regard to funding; the department does not provide stipends for students in the MR program.

Degrees

- Soil Science (MR) (p. 213)
- Soil Science (MS) (p. 215)
- Soil Science (PhD) (p. 216)
- Soil Science (Minor) (p. 217)

Faculty

Aziz Amoozegar
Area of Research: Environmental Soil Physics

Stephen W. Broome
Area of Research: Environmental Soil Science

David A. Crouse
Area of Research: Soil Science Education

Owen W. Duckworth
Area of Research: Soil Biogeochemistry

Alan J. Franzluebbers
Area of Research: Soil Ecology and Management

John L. Havlin
Area of Research: Soil Fertility

Joshua L. Heitman
Area of Research: Soil Physics & Hydrology

Richard A. McLaughlin
Area of Research: Urban Soil & Water Management

Michael D. Mullen
Area of Research: Soil Biology & Soil Science Education

Deanna L. Osmond
Area of Research: Soil Fertility & Watershed Management

Wei Shi

Area of Research: Soil Microbiology & Ecology

Michael J. Vepraskas
Area of Research: Wetland Soils & Pedology

Associate Professors

Alexandria K. Graves
Area of Research: Soil Microbiology

Kevin Garcia
Area of Research: Plant-Microbe Interactions & Nutrient Transport

Terrence G. Gardner
Area of Research: Soil & Environmental Microbial Ecology

Luciano C. Gatiboni
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Amy M. Johnson
Area of Research: Soil Science

Stephanie B. Kulesza
Area of Research: Nutrient Management and Animal Waste

Hui Li

Matthew C. Ricker
Area of Research: Pedology

Alex L. Woodley
Area of Research: Sustainable Agricultural Systems

Practice/Research/Teaching Professors

Robert E. Austin
Area of Research: Geospatial Information and Analytics in Soils, Agriculture and Environmental Science

Stanley W. Buol

Keith Cassel

Maurice Cook

Fred Cox

Carl Crozier

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Dean L. Hesterberg

Daniel Israel

Joseph Kleiss

David Lindbo

Gordon Miner

George C. Naderman Jr.

Wayne Robarge

Thomas J. Smyth

Richard Volk

Michael Wagger

Jeffrey G. White

Arthur Wollum

Soil Science (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**5-8**	
SSC 601	Seminar [1]		
SSC 620	Special Problems [2]		
Core Courses		**4-7**	
Select four of the following courses:			
SSC 511	Soil Physics		
SSC 521	Soil Chemistry		
SSC 532	Soil Microbiology		
SSC 541	Soil Fertility		
SSC 551	Soil Morphology, Genesis and Classification		
Undergraduate Courses		**6**	
400-Level undergraduate courses from outside soil science will be determined in conjunction with the academic committee			
Elective Courses		**18**	
"Elective Courses" will be determined in conjunction with the academic committee [4]			
Total Hours		**36**	

1. Students can take no more than two credits of SSC 601 Seminar total.
2. Students can take four to six credits of SSC 620 Special Problems.
3. Students may have courses waived upon proving competency in the following coursework
4. Students must take at least 18 hours of letter-graded course work – these must be NC State courses or inter-institutional courses (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

Additional Requirements

All Masters students must demonstrate competence in four of the five sub-disciplines listed below, and Doctoral students must demonstrate competency in all five.

- Soil Chemistry
- Soil Fertility and Plant Nutrition
- Soil Genesis and Classification
- Soil Microbiology and Biochemistry
- Soil Physics

The required competencies can be achieved by any combination of the following:

1. relevant course work from previous undergraduate and/or graduate degree programs;
2. prior professional experience in the major sub-discipline(s); and
3. graduate courses included in the student's Plan of Work (POW) for their current degree program.

Faculty

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Area of Research: Environmental Soil Physics

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Richard Volk

Michael Wagger

Jeffrey G. White

Arthur Wollum

Soil Science (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**7-14**	
SSC 601	Seminar [1]		
SSC 620	Special Problems [2]		
SSC 693	Master's Supervised Research [3]		
or SSC 695	Master's Thesis Research		
Core Courses		**4-7**	
Select four of the following courses: [4]			
SSC 511	Soil Physics		
SSC 521	Soil Chemistry		
SSC 532	Soil Microbiology		
SSC 541	Soil Fertility		
SSC 551	Soil Morphology, Genesis and Classification		
Undergraduate Courses		**6**	
400-Level undergraduate courses from outside soil science will be determined in conjunction with the academic committee			
Elective Courses		**18**	
"Elective Courses" will be determined in conjunction with the academic committee [5]			
Total Hours		**30**	

1. Students can take no more than two credits of SSC 601 Seminar total.
2. Students can take four to six credits of SSC 620 Special Problems.
3. Students are required to take a minimum of two credits and no more than six credits of SSC 693 Master's Supervised Research or SSC 695 Master's Thesis Research.
4. Students may have courses waived upon proving competency in the following coursework
5. Students must take at least 18 hours of letter-graded course work – these must be NC State courses or inter-institutional courses (https://studentservices.ncsu.edu/your-classes/exchange-programs/inter-institutional-program/).

Additional Requirements

- Successful completion of a research problem
- Non-credit exit seminar
- Additional credit hours of seminar and research may be taken in addition to the required 30 credit hours to fulfill continuous registration requirements, but do not need to be listed on the POW

Faculty

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Arthur Wollum

Soil Science (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3**	
SSC 801	Seminar [1]		
SSC 893	Doctoral Supervised Research [2]		
or SSC 895	Doctoral Dissertation Research		
Core Courses		**34**	
SSC 511	Soil Physics		
SSC 521	Soil Chemistry		
SSC 532	Soil Microbiology		
SSC 541	Soil Fertility		
SSC 551	Soil Morphology, Genesis and Classification		
Elective Courses		**tbd**	
"Elective Course" will be determined in conjunction with the academic committee			
Total Hours		**72**	

1. Students must take at least one credit of SSC 801 Seminar.
2. Students are required to take a minimum of two credits of SSC 893 Doctoral Supervised Research or SSC 895 Doctoral Dissertation Research.

Additional Requirements

All Doctoral students must demonstrate competence in the five soil science sub-disciplines listed below.

- Soil Chemistry
- Soil Fertility and Plant Nutrition
- Soil Genesis and Classification
- Soil Microbiology and Biochemistry
- Soil Physics

The required competencies can be achieved by any combination of the following:

1. relevant course work from previous undergraduate and/or graduate degree programs;
2. prior professional experience in the major sub-discipline(s); and
3. graduate courses included in the student's Plan of Work (POW) for their current degree program.

- Completion of at least 72 semester credit hours beyond the bachelor's degree
  - If the student has an MS degree from another institution, a maximum of 18 hours of relevant graduate credit from that degree may be applied toward this minimum, upon the recommendation of the student's Graduate Advisory Committee, and the minimum required will be 54 semester credit hours
  - If a student completes an MS degree at NC State and continues for a doctoral degree without a break in time, up to 36 relevant credit hours taken while in master's status may be used to meet minimum requirements for the doctoral degree. If there is a break in time between completing the master's (at NC State) and beginning the doctorate (at NC State), the allowance is limited to 18 hours. Either allowance may include those 400-level courses taken as an approved part of the MS degree.
- Completion of preliminary written and oral examinations must be completed within six calendar years from the date of admission
- Successful completion of an original research program
- Success completion of the final oral examination
- Completion of a non-credit exit seminar

Faculty

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Soil Science (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of Soil Science coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of Soil Science coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Youth, Family, & Community Sciences

The Youth, Family & Community Sciences Program provides graduate study for current and emerging professionals in family life education, parent education, family life coaching, youth development, volunteer management, and community-based youth and family programs, or

related careers. The demand for professionals to teach, administer, and create support systems for children, youth and families is increasing through Cooperative Extension programs, government agencies and initiatives, community-based non-pro#ts, court systems, prisons, social service organizations, health care agencies/organizations, and schools.

The following distance-based graduate programs are available:

- Master of Science in Youth, Family, and Community Sciences (M.S. requires 36 total hours including a thesis)
- Master of Youth, Family, and Community Sciences (M.R. requires 30 hours and a culminating supervised professional experience)

Admission Requirements

Students apply through NC State via the normal Graduate School admissions procedures; applications are reviewed on Nov.1 and July 1. All application materials must be submitted electronically (online); mailed or faxed materials are not accepted. Only complete applications are reviewed. In addition to all Graduate School admission requirements, the Department requires three academic references, a personal statement of current/future career goals including how this program will help you reach your goals, and a 500-800 word academic writing sample that answers the following prompt: What is the role of family science in a diverse society? The Graduate School requires a 3.00 average (4.00 scale) in the undergraduate program. The most quali#ed applicants will be accepted up to the number of spaces that are available for new students. Exceptions to the minimum grade point average may be made for students with special backgrounds, abilities, circumstances, or interests.

Master’s Degree Requirements

The Master of Science in Youth, Family, and Community Sciences (M.S.) requires 36 hours culminating in a #nal oral examination and thesis approved by the student’s graduate committee. The Master of Youth, Family, and Community Sciences (M.R.) is a non-thesis degree that requires a total of 30 credit hours culminating in a capstone supervised professional experience. Both degree programs are built upon foundations of theory and application composed of four focus areas: (1) foundations of family life and youth development, (2) professional development and leadership, (3) research and methodological inquiry, and (4) content area concentration.

Student Financial Support

No #nancial aid/assistantships are available directly from the Department. Financial aid is available from the NC State Of#ce of Financial Aid and on a competitive basis from the NC State Graduate School. Students seeking #nancial aid should contact the NC State Financial Aid Of#ce directly.

Other Relevant Information

Distance course delivery methods include: totally asynchronous web-based classes, and synchronous Internet based classes. The M.R. and M.S. programs may be successfully completed totally via distance.

Degrees

- Youth, Family, and Community Sciences (MR) (p. 219)
- Youth, Family, and Community Sciences (MS) (p. 221)
- Family Life Education and Coaching (Certificate) (p. 222)
- Leadership and Volunteer Management (Certificate) (p. 222)
- Youth Development and Leadership (Certificate) (p. 223)

Faculty

Full Professors

Carolyn Bird

Benjamin Chapman

Carolyn Dunn

Sarah Kirby

Michael Schulman

Benjamin Silliman

Associate Professors

Dara Bloom

Harriett C. Edwards

Annie Hardison-Moody

Lindsey Haynes-Maslow

Assistant Professors

Jamie Alexander

Mitzi Downing

Maru Gonzalez

Lecturer

Autumn Guin

Emeritus Faculty

Lucille Bearon

Karen DeBord

Youth, Family, and Community Sciences (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
The following courses are required:			

YFCS 500	Supervised Professional Experience in Family Life & Youth Development	
YFCS 502	Theories in Family Science	
YFCS 551	Research Methods in Youth, Family, and Community Sciences	
YFCS 552	Program Development & Evaluation in Youth & Family Settings	
YFCS 585	Professional Ethics and Family Policy	
Applied Concepts Course		**3**
YFCS 543	Applied Concepts in Parenting and Family Life Education	
or YFCS 553	Applied Concepts in Child and Youth Development	
Elective Courses		**12**
Select four courses from "Elective Courses" listed below		
Total Hours		**30**

Elective Courses

Code	Title	Hours	Counts towards
Select fours courses below		**12**	
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 547	Family Life Coaching		
YFCS 550	Family and Youth Professionals as Leaders		
YFCS 557	Volunteerism in Youth and Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 590	Special Topics Family Life and Youth Development		
YFCS 630	Independent Study in Family Life & Youth Development		
ST 511	Statistical Methods For Researchers I		

Faculty

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Youth, Family, and Community Sciences (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
YFCS 500	Supervised Professional Experience in Family Life & Youth Development		
YFCS 502	Theories in Family Science		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 585	Professional Ethics and Family Policy		
Applied Concepts Course		**3**	
YFCS 543	Applied Concepts in Parenting and Family Life Education		
or YFCS 553	Applied Concepts in Child and Youth Development		
Methodological Inquiry Courses		**9**	
YFCS 551	Research Methods in Youth, Family, and Community Sciences		
YFCS 695	Thesis Research		
ST 511	Statistical Methods For Researchers I		
Elective Courses		**12**	
See "Elective Courses" listed below			
Total Hours		**36**	

Elective Courses

Code	Title	Hours	Counts towards
Select four courses below		**12**	
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 547	Family Life Coaching		
YFCS 550	Family and Youth Professionals as Leaders		
YFCS 557	Volunteerism in Youth and Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 590	Special Topics Family Life and Youth Development		
YFCS 630	Independent Study in Family Life & Youth Development		

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Family Life Education and Coaching (Certificate)

The Graduate Certificate in Family Life Education and Coaching prepares students to work with parents, professionals, and families as both family life educators and family life coaches. Family Life Educators (FLE) are strengths-based professionals who provide preventative research-based education to families in organized efforts designed to impart information, skills, experiences, or resources to strengthen, improve, or enrich their family experience. Family Life Coaches (FLC) partner with clients in a thought-provoking and creative process that inspires families to maximize their potential, reach goals, and achieve healthy relationships. Required courses are designed to strengthen the student's understanding and application of the critical aspects of family life coaching and education, including a strengthened understanding of the fields of coaching psychology and family life education. The 12-credit graduate program can be completed entirely online.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
YFCS 543	Applied Concepts in Parenting and Family Life Education		
YFCS 545	Family Communication and Coaching		
YFCS 547	Family Life Coaching		
Elective Course		**3**	
See "Elective Courses" listed below			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
Select one of the following electives that most aligns with your professional interests:		**3**	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 537	Human Sexuality		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 553	Applied Concepts in Child and Youth Development		
YFCS 585	Professional Ethics and Family Policy		

Leadership and Volunteer Management (Certificate)

A Youth, Family, and Community Sciences Online Graduate Certificate in Leadership and Volunteer Management prepares students to work as leaders in community-based organizations. It prepares and strengthens future and current professionals to assume administrative positions and leadership roles within community-based youth or family development. Students gain a more comprehensive understanding of organizational leadership, as well as an applied understanding of effective management skills. The certificate is intended to enhance a student's work in organizational administration and/or volunteer management including volunteer recruitment, retention, risk management, and recognition.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
YFCS 550	Family and Youth Professionals as Leaders		
YFCS 557	Volunteerism in Youth and Family Settings		
Organizational Administration Course		**3**	
See "Organizational Administration Courses" listed below			
Elective Course		**3**	
See "Elective Courses" listed below			
Total Hours		**12**	

Organizational Administration Courses

Code	Title	Hours	Counts towards
Select one of the following electives in Organizational Administration		**3**	
YFCS 531	Effective Management of Family Resources		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 557	Volunteerism in Youth and Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 585	Professional Ethics and Family Policy		

Elective Courses

Code	Title	Hours	Counts towards
Select one of the following electives as related to your career interests		**3**	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 535	Family Health & Well-being		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 585	Professional Ethics and Family Policy		

Youth Development and Leadership (Certificate)

The Graduate Certificate in Youth Development and Leadership prepares future and strengthens current professionals working with community-based youth development programs. The required courses are designed to strengthen the student's understanding and application of critical aspects of community youth programs, including theories of youth development, social, emotional, cognitive, and physical development, resource development and management, volunteer development, advisory committees and boards, organizational structure, human resource management, and current/emerging issues impacting youth and families.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
YFCS 550	Family and Youth Professionals as Leaders	3	
YFCS 553	Applied Concepts in Child and Youth Development	3	

Organizational Administration Course	**3**
See "Organizational Administration Electives" listed below	
Youth / Family Development Elective Course	**3**
See "Youth and Family Development Electives" listed below	
Total Hours	**12**

Organizational Administration Courses

Code	Title	Hours	Counts towards
Select one of the following courses:		**3**	
YFCS 531	Effective Management of Family Resources		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 557	Volunteerism in Youth and Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 585	Professional Ethics and Family Policy		

Youth and Family Development Courses

Code	Title	Hours	Counts towards
Select one of the following courses:		3	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 535	Family Health & Well-being		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 585	Professional Ethics and Family Policy		

Graduate Certificates - College of Agriculture and Life Sciences

Certificates

- Agricultural and Extension Education (Certificate) (p. 80)
- Agriculture Data Science (Certificate) (p. 225)
- Family Life Education and Coaching (Certificate) (p. 222)
- Feed Science (Certificate) (p. 211)
- Horticultural Science (Certificate) (p. 163)
- Leadership and Volunteer Management (Certificate) (p. 222)
- Leadership in Agriculture Human Sciences (Certificate) (p. 230)
- Molecular Biotechnology (Certificate) (p. 230)
- Regulatory Science in Agriculture (Certificate) (p. 231)
- Watershed Assessment and Restoration (Certificate) (p. 232)
- Youth Development and Leadership (Certificate) (p. 223)

Agricultural and Extension Education (Certificate)

The Department of Agricultural and Extension Education offers a Graduate Certificate in Agricultural and Extension Education. The program focuses on developing knowledge and skills needed to be effective teachers of agriculture in the public schools and community colleges or to work as an educator with the Cooperative Extension Service or in other non-formal educational settings such as public gardens, nature centers and in international development.

Admissions

Students apply online by visiting the Graduate School's website and completing an online application. Students currently in a graduate degree program should contact the program director for information regarding adding the certificate program to an existing degree program.

Requirements

The certificate program involves completion of 15 credit hours and the preparation of a professional portfolio. The career goals of the student will determine which sequence of courses to take.

Plan Requirements

The Graduate Certificate in Agricultural and Extension Education is divided into two focuses: Agricultural Education and Extension Education.

Certificates earned will be distributed as: "Graduate Certificate in Agricultural Education and Extension Education" without focus area specifications.

Code	Title	Hours	Counts towards
Select a Focus Area below, and select at least 5 courses within the corresponding list:		**15**	
Agricultural Education focus			
AEE 500	Agricultural Education, Schools and Society		
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 503	Youth Program Management		
AEE 522	Occupational Experience in Agriculture		
AEE 524	Coordinating the High School Agricultural Education Program		
AEE 529	Curriculum Development in Agricultural and Extension Education		
AEE 535	Teaching Agriculture in Secondary Schools		
AEE 641	Practicum In Agricultural and Extension Education		
AEE 735	Effective Teaching in Agriculture and Life Sciences		
Extension Education focus			
AEE 501	Foundations Of Agricultural and Extension Education		
AEE 521	Program Planning in Agricultural and Extension Education		
AEE 523	Adult Education in Agriculture		
AEE 533	Leadership and Management of Volunteers in Agricultural and Extension Education		
AEE 560	Organizational Behavior and Administrative Leadership in Agricultural & Human Science		
AEE 577	Evaluation in Agricultural and Extension Education		
AEE 705	International Agricultural Development		
AEE 641	Practicum In Agricultural and Extension Education		
Total Hours		**15**	

Agriculture Data Science (Certificate)

All areas of agriculture, food, and life science have seen an explosion in data collection, ranging from plant breeders collecting phenotypic information to drones imaging fields to companies accumulating sales information. Professionals in industry, governmental, non-governmental and academics need post-baccalaureate training on how to properly collect, manage and analyze the data and then make appropriate decisions using the data.

Students will be able to take their training in this certificate in many different directions depending on their educational and employment needs. In data mining and predictive modeling, our students look for useful patterns in large data sets that would allow them to understand the past and better predict the future. In artificial intelligence and the related processes of machine learning and deep learning, our students will go several steps further, creating machines and algorithms that not only analyze and understand data, but also take the next logical steps dictated by the data.

This program will combine SAS data management and analysis techniques with computer science and statistical training to allow students to apply the processes of data mining and artificial intelligence to critical agriculture, food and life science issues. This certificate is intended for those students who have completed a BS degree in agriculture, food or life science and need additional training to be able to manage and use data in their fields. This certificate is also intended for those students who have completed a BS degree in computer science, mathematics or statistics and need additional training in how to apply data science techniques to agriculture, food and life science data issues. Students currently enrolled in a graduate program will also be eligible to complete the certificate.

Plan Requirements

Certificates are distributed as "Graduate Certificate in Agriculture Data Science" without track specifications.

Code	Title	Hours	Counts towards
Required Courses		**6**	
ST 525	Statistics and Computing for Agricultural Data Science		
BAE 542	Advanced Analytics to Agriculture, Food and Life Sciences Data		
Track Requirements		**6**	
Select one of the following tracks:			
Track A: Data Science Fundamentals (p. 226)			
Track B: Data Science Applications in Agriculture, Food, Life Science, and Agricultural Economics (p. 226)			
Total Hours		**12**	

Track A: Data Science Fundamentals

Code	Title	Hours	Counts towards
Select 6 hours of the following courses:			
BAE 555/455	R Coding for Data Management and Analysis	3	
BAE 565	Environmental and Agricultural Analytics and Modeling	3	
CSC 440	Database Management Systems	3	
CSC/ST 442	Introduction to Data Science	3	
CSC 505	Design and Analysis Of Algorithms		
CSC 520	Artificial Intelligence I		
CSC 530	Computational Methods for Molecular Biology		
CSC 540	Database Management concepts and Systems		
CSC 541	Advanced Data Structures		
ST 563	Introduction to Statistical Learning	3	
ECE 488/588/ PB 488/588	Systems Biology Modeling of Plant Regulation	3	
ECE 542	Neural Networks	3	

Track B: Data Science Applications in Agriculture, Food, Life Science and Agricultural Economics

Code	Title	Hours	Counts towards
Select 6 hours of the following courses:			
AEHS 777	Qualitative Research Methods in the Agricultural Education and Human Sciences	3	
AEC 510	Machine Learning Approaches in Biological Sciences	2	
AEC/FW 726	Quantitative Fisheries Management	3	
ANS/GN 713	Quantitative Genetics and Breeding		
ANS/CS/FOR 726	Advanced Topics In Quantitative Genetics and Breeding	3	
BAE 535	Precision Agriculture Technology	3	
BAE 536	GIS Applications in Precision Agriculture	1	
CS 714	Crop Physiology: Plant Response to Environment		
CS/HS/GN 745	Quantitative Genetics In Plant Breeding	1	
CS 755	Applied Research Methods and Analysis for Plant Sciences	3	
ECG/ST 561	Applied Econometrics I	3	
ECG 562	Applied Econometrics II	3	
ECG 563	Applied Microeconometrics	3	
ECG 590	Special Economics Topics		

ECG/ST 750	Introduction to Econometric Methods	
ECG/ST 751	Econometric Methods	
ECG/ST 752	Time Series Econometrics	
ECG/ST 753	Microeconometrics	
ECG 766	Computational Methods in Economics and Finance	
ECG 739	Empirical Methods for Development Economics and Applied Microeconomics	3
ENT/GES 506	Principles of Genetic Pest Management	
GN 550/450	Conservation Genetics	3
GN/HS/ST 757	Quantitative Genetics Theory and Methods	3
PP/MB 715	Applied Evolutionary Analysis of Population Genetic Data	
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture	3
SSC 545	Remote Sensing Applications in Soil Science and Agriculture	

Cybersecurity (Certificate)

The Graduate Certificate in Cybersecurity (CYS GCP) is designed for students with prior training in Computer Science and/or Electrical and Computer Engineering. The certificate will provide students with the latest technical knowledge and skills in cybersecurity and privacy principles and the engineering aspects of software and hardware security to build secure systems that are resistant to attack.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
CSC 574	Computer and Network Security		
CSC/ECE 595	Cybersecurity Practium		
Additional Courses		**6**	

Select two of the following courses:

CSC 514	Foundations of Cryptography	
CSC 515	Software Security	
CSC 533	Privacy in the Digital Age	
CSC 537	Systems Attacks and Defenses	
CSC 705	Operating Systems Security	
CSC 774	Advanced Network Security	
ECE 592	Special Topics In Electrical Engineering (Cryptographic Engineering and Hardware Security)	
Total Hours		**12**

Family Life Education and Coaching (Certificate)

The Graduate Certificate in Family Life Education and Coaching prepares students to work with parents, professionals, and families as both family life educators and family life coaches. Family Life Educators (FLE) are strengths-based professionals who provide preventative research-based education to families in organized efforts designed to impart information, skills, experiences, or resources to strengthen, improve, or enrich their family experience. Family Life Coaches (FLC) partner with clients in a thought-provoking and creative process that inspires families to maximize their potential, reach goals, and achieve healthy relationships. Required courses are designed to strengthen the student's understanding and application of the critical aspects of family life coaching and education, including a strengthened understanding of the fields of coaching psychology and family life education. The 12-credit graduate program can be completed entirely online.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
YFCS 543	Applied Concepts in Parenting and Family Life Education		
YFCS 545	Family Communication and Coaching		
YFCS 547	Family Life Coaching		
Elective Course		**3**	
See "Elective Courses" listed below			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
Select one of the following electives that most aligns with your professional interests:		**3**	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 537	Human Sexuality		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 553	Applied Concepts in Child and Youth Development		
YFCS 585	Professional Ethics and Family Policy		

Feed Science (Certificate)

The Graduate Certificate Program in Feed Science is designed to prepare professionals or current degree program students to work in or alongside the animal food industry. The program will provide an advanced foundation in feed science technology, quality assurance and feed formulation, and feed industry leadership. The objectives of this program are for the student to acquire an understanding of the technical aspects of modern animal food manufacturing; food and ingredient quality assurance; animal food safety; feed industry regulations; facility operations, leadership, and safety; formulation; and generally how to apply technical skills to the challenges of the global animal food industry.

Admission Requirements

Applicants must have a BS/BA degree or equivalent four year degree in order to apply to the program. Individuals interested in this certificate program must contact the coordinator of the certificate program.

Program Requirements

A minimum of 12 credit hours from the prescribed list of courses and a grade of 'C-' or better in these courses is required to receive credit for the certificate. To receive a Graduate Certificate in Feed Science, a student must have a minimum 3.0 grade point average on all certificate course work. All course work must be registered through NC State University, transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the application is approved by the Director of Graduate Programs.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
FM/ANS/NTR/ PO 525	Feed Manufacturing Technology		
FM/PO 580	Feed and Ingrdient Quality Assurance		
PO/ANS/NTR 515	Comparative Nutrition		
Elective Courses			
Select a minimum of one of the following courses:		3	
FM 460/ PO 590	Feed Mill Operations and Leadership		
FM 490	Feed Science Seminar		
FM 594	Advanced Feed Mill Practicum		
FM/NTR 790	Advanced Feed Formulation		
Total Hours		**12**	

Horticultural Science (Certificate)

The Graduate Certificate is a non-degree, designed to increase personal knowledge and skills for current or future employment in the horticulture industry. Earning the Graduate Certificate requires completing a minimum of 15 credit hours (usually equaling 5 courses) of coursework. Courses may be taken either on-line or face-to-face.

Participants must hold a bachelor’s degree to enroll in this program. Graduate Certificate applicants should have majored in horticulture, crop science, plant science, or agricultural education with a concentration in plant science, or another closely related degree. Students may begin taking courses for the graduate certificate in Summer, Fall, or Spring. All graduate certificate course work must be completed within four years of enrollment.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of three courses from the following:			
HS 502	Plant Disease: Methods & Diagnosis		
HS 516	Planting Design		
HS 520	Green Infrastructure		

HS 521	Temperate-Zone Tree Fruits: Physiology and Culture	
HS 523	Viticulture	
HS 532	Introduction to Permaculture *	
HS 533	Public Garden Administration	
HS/CS 541	Plant Breeding Methods *	
HS 550	Environmental Nursery Production *	
HS 551	Plant Nutrition *	
HS/FS 562	Postharvest Physiology *	
HS 576	Crop Physiology and Production in Controlled Environments	
HS 601	Professional Presentation Skills in Horticultural Science *	
HS 703	Breeding Asexually Propagated Crops	
HS 704	Plant Nomenclature	
HS 705	Physiology Of Flowering	
HS 707	Environmental Stress Physiology	
HS 717	Weed Management Systems	
HS 725	Pesticide Chemistry	
HS 727	Pesticide Behavior and Fate In the Environment	
HS 757	Quantitative Genetics Theory and Methods	
Additional Courses [1]		**6**
Additional Courses are determined in conjunction with the academic committee to meet the 15 total hours		
Total Hours		**15**

* Courses taught online

1 Students must take courses that meet the following requirements: must be at 500-level or higher, letter-graded, passed with a B or better

2 Students can select a maximum of 6 hours from the following subjects: ARE, AEE, BAE, CS, ENT, FS, PP, SCC; courses must be at 400-level or higher.

Leadership and Volunteer Management (Certificate)

A Youth, Family, and Community Sciences Online Graduate Certificate in Leadership and Volunteer Management prepares students to work as leaders in community-based organizations. It prepares and strengthens future and current professionals to assume administrative positions and leadership roles within community-based youth or family development. Students gain a more comprehensive understanding of organizational leadership, as well as an applied understanding of effective management skills. The certificate is intended to enhance a student's work in organizational administration and/or volunteer management including volunteer recruitment, retention, risk management, and recognition.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
YFCS 550	Family and Youth Professionals as Leaders		
YFCS 557	Volunteerism in Youth and Family Settings		
Organizational Administration Course		**3**	
See "Organizational Administration Courses" listed below			
Elective Course		**3**	
See "Elective Courses" listed below			
Total Hours		**12**	

Organizational Administration Courses

Code	Title	Hours	Counts towards
Select one of the following electives in Organizational Administration		**3**	
YFCS 531	Effective Management of Family Resources		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		

YFCS 557	Volunteerism in Youth and Family Settings
YFCS 558	Contemporary Issues in Volunteer Resource Management
YFCS 585	Professional Ethics and Family Policy

Elective Courses

Code	Title	Hours	Counts towards
Select one of the following electives as related to your career interests		**3**	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 535	Family Health & Well-being		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 585	Professional Ethics and Family Policy		

Leadership in Agriculture Human Sciences (Certificate)

As we look at the grand challenges our world faces, the need to train and prepare leaders in every sector of society is urgent. For those interested in developing and strengthening their leadership skills, the Agricultural and Human Sciences (AHS) Department in the College of Agriculture and Life Sciences offers the Graduate Certificate in Leadership in Agricultural & Human Sciences (GCLAHS). The GCLAHS will consist of five 3-credit courses that focus on theory, organizational leadership, community leadership, critical and creative thinking, and change management. This certificate is designed for the individual who is either currently in a leadership role or who aspires to serve in a leadership capacity in education, industry, non-profit or government. The curriculum allows for a strong base in theory and practice, under the direction of leadership scholars who will work with students to take the knowledge gained in the classroom and apply that knowledge to their respective contexts. In fact, this is the essential nature of leadership development, for students to be able to contextualize the work to their own specific context. Courses are offered online to accommodate the busy schedules of working professionals.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
AEHS 545	Family Communication and Coaching		
AEHS 550	Leadership Theory		
AEHS 555	Critical and Creative Thinking (pending ABGS approval Spring 2022)		
AEHS 560	Organizational Behavior and Administrative Leadership in Agricultural & Human Science		
AEHS 565	Community Leadership		
Total Hours		**15**	

Molecular Biotechnology (Certificate)

Training in molecular biotechnology is essential for a wide range of disciplines from microbiology, plant and animal sciences to chemical engineering. The Graduate Certificate Program in Molecular Biotechnology offers an opportunity for individuals educated in the life sciences and related disciplines to gain laboratory-based, hands-on molecular biology training.

Admission Requirements

1. Baccalaureate degree in a science or engineering discipline.
2. Minimum GPA of 2.75 in his/her/they undergraduate program, and a recommended minimum GPA of 3.0 in science courses.
3. All prerequisites (or their equivalent) to BIT 510 completed before beginning the certificate program. The minimum requirements for BIT 510 are: MB 351 or GN 311 (or equivalent) and two semesters of organic chemistry (equivalent to CH 221 and CH 223). Prerequisites for the coursework electives vary, and those

prerequisites may be taken after admission to the certificate program if necessary.

4. Note that currently the Certificate is only available to students enrolled in a Masters Degree program at NC State.

Certificate Degree Requirements

The Graduate Certificate Program in Molecular Biotechnology will require a minimum of 12 hours of required and elective courses. Coursework transferred from another institution is not applicable toward the certificate. Award of the certificate requires an overall GPA of 3.0 or better for certificate courses (required and elective) with a minimum grade of B- in any of the BIT courses and a minimum grace of C in coursework electives.

Other Relevant Information

NC State graduate students with career interests that involve molecular biotechnology, but are not eligible for the minor, are eligible to apply for the certificate.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
BIT 501	Ethical Issues in Biotechnology [1]		
BIT 510	Core Technologies in Molecular and Cellular Biology (+ Capstone Cloning Project) [2]		
Elective Courses		**3**	
See "Elective Courses" listed below [3]			
Total Hours		**12**	

1. Students may take another approved research ethics/bioethics course determined in conjunction with the academic committee
2. Upon passing BIT 510 Core Technologies in Molecular and Cellular Biology with an 80% or higher, students must complete a Capstone Cloning Project.
3. Students may choose another 500-level or higher elective course outside "Elective Courses" listed below determined in conjunction with the academic committee

Elective Courses

Code	Title	Hours	Counts towards
Select courses from the lists below:		**3**	
BIT Electives			
BIT 564	Protein Purification	2	
BIT 566	Animal Cell Culture Techniques	2	
BIT 577	Metagenomics	2	
BIT 579	High-Throughput Discovery	2	
BIT 595	Special Topics	1-6	
BIT 571	RNA Interference and Model Organisms	2	
BIT 572	Proteomics	3	
BIT 573	Protein Interactions	2	
BIT 580	Yeast Metabolic Engineering	2	
BIT 815	Advanced Special Topics	1-6	
Other Elective Courses			
MB 714	Microbial Metabolic Regulation	3	
MB 758	Microbial Genetics & Genomics	3	
BCH 553	Biochemistry of Gene Expression	3	
MB 725	Fermentation Microbiology	3	
GN 721	Genetic Data Analysis	3	
GN 701	Molecular Genetics	3	
GN 735	Functional Genomics	3	
CHE 551	Biochemical Engineering	3	

Regulatory Science in Agriculture (Certificate)

Regulatory Science is a field critical to the advancement of responsible technologies for agriculture from concept, through research and development, to commercialization, and throughout a technology's life. The Graduate Certificate in Regulatory Science in Agriculture is an interdisciplinary certificate bringing together science and policy. Students will learn the science, techniques and policies underpinning agriculture regulation as well as risk management, compliance, data assessment, and regulatory communications.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
CS 518	Introduction to Regulatory Science in Agriculture		
CS 528	Advanced Regulatory Science in Agriculture		
Elective Courses [1]		**6**	
BCH 552	Experimental Biochemistry		

BCH 553	Biochemistry of Gene Expression
BCH 555	Proteins and Molecular Mechanisms
BIO/BIT 572	Proteomics
CH 563	Molecular Origins of Life
CH 711	Advanced Analytical Chemistry I
CH 721	Advanced Organic Chemistry I
CH 723	Advanced Organic Chemistry II
CS 725	Pesticide Chemistry
CS 727	Pesticide Behavior and Fate In the Environment
COM 508	Emerging Technologies and Society
COM 538	Risk Communication
EA 501	Environmental Stressors
EA 502	Environmental Risk Assessment
EA 503	Environmental Exposure Assessment
EA 504	Environmental Monitoring and Analysis
EA 505	Environmental Assessment Law & Policy
PA 507	The Public Policy Process
PA 511	Public Policy Analysis
PA 550	Environmental Policy
PA 552	Science and Technology Policy
PA 763	Public Policy Process
PS 531	International Law
SSC 562	Environmental Applications Of Soil Science
SSC 720	Soil and Plant Analysis
TOX 501	Principles of Toxicology
TOX 620	Special Problems
TOX 710	Molecular and Biochemical Toxicology
Total Hours	**12**

[1] The six credits of electives must come from two distinct disciplines.

Watershed Assessment and Restoration (Certificate)

The Department of Biological and Agricultural Engineering offers a Graduate Certificate Program in Watershed Assessment and Restoration.

Objectives

- Provide a focus and formal program for students from many disciplines to pursue training in the technical and engineering aspects of designing and analyzing environmental systems with an emphasis on the watershed-scale.
- Provide students the opportunity to develop a solid foundation in engineering systems targeted at environmental issues, particularly related to non-point sources and their impact on water quality at the watershed-scale.
- Provide practicing engineers and other professionals a source of graduate level engineering education in the environmental field.

Admission Requirements

Applicants must have successfully completed an accredited undergraduate engineering program with a GPA of 3.0 (based on a 4.0 scale), or with an overall undergraduate GPA of at least 2.8 coupled with a 3.0 or higher in the undergraduate major, or be currently enrolled in a graduate engineering program. Applicants with a four-year undergraduate science degree who have successfully completed (with a C or better) calculus, differential equations, physics and chemistry will also be considered. A program that includes fluid mechanics or hydraulics is highly recommended. Environmental professionals who do not meet the above criteria may also qualify if appropriate experience can be demonstrated.

Program Requirements

A minimum of 12 hours of coursework selected from the list below. One course can be selected from outside of BAE (up to 2 credit hours), but at least 9 credit hours must be BAE courses.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
Select three of the following courses:			
BAE 535	Precision Agriculture Technology		

BAE 536	GIS Applications in Precision Agriculture	
BAE 572	Irrigation and Drainage	
BAE 573	Introduction to Hydrologic and Water Quality Modeling	
BAE 574	DRAINMOD: Theory and Application	
BAE 575	Design of Structural Stormwater Best Management Practices	
BAE 576	Watershed Monitoring and Assessment	
BAE 578	Agricultural Waste Management	
BAE 577	Wetlands Design and Restoration	
BAE 580	Introduction to Land and Water Engineering	
BAE 581	Open Channel Hydraulics for Natural Systems	
BAE 582	Risk and Failure Assessment of Stream Restoration Structures	
BAE 583	Stream Corridor 3 Es: Ecohydraulics, Engineering and Ethics	
BAE 584	Introduction to Fluvial Geomorphology	
BAE 771	Theory Of Drainage--Saturated Flow	
Elective Course		**3**
"Elective Course" will be determined in conjunction with the academic committee		
Total Hours		**12**

Youth Development and Leadership (Certificate)

The Graduate Certificate in Youth Development and Leadership prepares future and strengthens current professionals working with community-based youth development programs. The required courses are designed to strengthen the student's understanding and application of critical aspects of community youth programs, including theories of youth development, social, emotional, cognitive, and physical development, resource development and management, volunteer development, advisory committees and boards, organizational structure, human resource management, and current/emerging issues impacting youth and families.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
YFCS 550	Family and Youth Professionals as Leaders	3	
YFCS 553	Applied Concepts in Child and Youth Development	3	
Organizational Administration Course		**3**	
See "Organizational Administration Electives" listed below			
Youth / Family Development Elective Course		**3**	
See "Youth and Family Development Electives" listed below			
Total Hours		**12**	

Organizational Administration Courses

Code	Title	Hours	Counts towards
Select one of the following courses:		**3**	
YFCS 531	Effective Management of Family Resources		
YFCS 552	Program Development & Evaluation in Youth & Family Settings		
YFCS 557	Volunteerism in Youth and Family Settings		
YFCS 558	Contemporary Issues in Volunteer Resource Management		
YFCS 585	Professional Ethics and Family Policy		

Youth and Family Development Courses

Code	Title	Hours	Counts towards
Select one of the following courses:		3	
YFCS 502	Theories in Family Science		
YFCS 523	Family Relationships Over the Life Course		
YFCS 531	Effective Management of Family Resources		
YFCS 533	Complex Family Issues		
YFCS 535	Family Health & Well-being		
YFCS 537	Human Sexuality		
YFCS 540	Environmental Influences on the Family		
YFCS 545	Family Communication and Coaching		
YFCS 585	Professional Ethics and Family Policy		

College of Design

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Certificates

- City Design (Certificate) (p. 241)
- Disaster Resilient Policy, Engineering and Design (Certificate) (p. 263)
- Energy and Technology in Architecture (Certificate) (p. 242)
- Public Interest Design (Certificate) (p. 244)

Architecture

Master of Architecture

The School of Architecture offers two tracks to the Master of Architecture degree:

- Track 1 is for applicants with a four-year undergraduate pre-professional degree in architecture from a National Architecture Accrediting Board (NAAB) accredited program and may be completed in two years of full-time study;
- Track 3 normally requires three semesters of preparatory work before entering the final two-year program of graduate study. Some applicants with design-related academic or professional experience may be able to complete the preparatory work in less time.

A variety of courses are available within the School of Architecture in urban and community design, architectural history and theory, material fabrication, professional practice, building technology and environmental systems.

Master of Advanced Architectural Studies

The Masters of Advanced Architectural Studies is a two to three semester, innovative program for committed, self-directed students who have earned a professional degree in architecture, or a degree in a related discipline. Four focus areas – *City Design*, *Public Interest Design*, *Energy and Technology*, and *History and Theory* – provide opportunities for specialized study in leading edge areas of the built environment. They address the design of sustainable, regenerative, equitable and inclusive cities, suburbs, and buildings, and the means to interpret and assess built environments. All are designed as platforms to explore solutions to the crucial issues of the 21st century.

All degrees will be distributed as "Master of Advanced Architectural Studies" without focus area specifications.

Admission Requirements

In addition to documents required by the Graduate School, students apply to the Master of Architecture program by submitting the following documents by January 15:

1. Portfolio of work;
2. Completed School Personal Data Form;
3. TOEFL/ IELTS scores (foreign language students only).

Applicants will be considered on an individual basis. Exceptions to Graduate School policy may be made for students indicating other qualifications and professional experience.

Master's Degree Requirements

The school stipulates the minimum course credits based on educational and professional goals to individualize a plan of study.

Student Financial Support

The school awards scholarships, awards, and teaching assistantships competitively. It also supports national and statewide scholarships, fellowships, and awards. All support is merit based, not need based. No special application for such support is necessary at the time of admissions.

National Architectural Accrediting Board (NAAB)

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted a 8-year, 4-year, or 2-year term of accreditation, depending on the extent of its conformance with established educational standards.

Doctor of Architecture and Master of Architecture degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

The NC State University School of Architecture offers the following NAAB accredited degree programs:

- B.Arch (pre-professional degree + 30 graduate credits)
- M.Arch Track 1 (pre-professional degree + 48 graduate credits)
- M.Arch Track 3 (non-pre-professional degree + 96 credits)

Next Accreditation Visit for All Programs: 2026

Degrees

- Architecture (MR) (p. 235)
- Architecture (MR): History and Theory of Architecture Concentration (p. 238)
- Advanced Architectural Studies (MR) (p. 240)
- Architecture (Minor) (p. 240)
- City Design (Certificate) (p. 241)
- Energy and Technology in Architecture (Certificate) (p. 242)
- Public Interest Design (Certificate) (p. 244)

Faculty

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Architecture (MR)

Track 1 Degree Requirements

Track 1 is for students with a four-year undergraduate preprofessional degree in architecture (BEDA degree or equivalent).

Code	Title	Hours	Counts towards
Required Courses		**24**	
ARC 500	Architectural Design: Professional Studio [1]		
ARC 503	Advanced Architectural Design (Series) [1,2]		
ARC 503	Advanced Architectural Design (Series)		
or ARC 598	Final Project Studio In Architecture		
Elective Courses		**24**	
ARC 561	The Practice of Architecture [3]		
Select additional "Architecture Electives" to meet the 24 credit hours; up to 6 hours of "College of Design Electives" may be included [4]			
Total Hours		**48**	

1. The studio assignment will be determined by the School of Architecture prior to the semester start. ARC 503 Advanced Architectural Design (Series) will be repeated at least three times to meet the 18 credit hour requirement.
2. If the faculty approves the student to undertake a Final Project, the student will substitute ARC 598 Final Project Studio In Architecture for the last semester ARC 503 Advanced Architectural Design (Series) requirement and must take ARC 697 Final Project Research in Architecture as 3 credits of the "Architecture Electives".
3. ARC 561 The Practice of Architecture must be taken and counts toward the ARC Elective credits. This course can be taken any semester that ARC Electives appear in the curriculum.
4. "College of Design Electives" included courses offered within the College of Design with AD, D, Des, GD, ID, LAR course prefixes 400-level and above.

Semester Sequence

First Year		
Fall Semester		**Hours**
Required Course		6
ARC 500 or ARC 503	Architectural Design: Professional Studio or Advanced Architectural Design (Series)	
Architecture Electives [1]		6
	Hours	**12**
Spring Semester		
Required Course		6
ARC 500 or ARC 503	Architectural Design: Professional Studio or Advanced Architectural Design (Series)	
Architecture Electives [1]		6
	Hours	**12**
Second Year		
Fall Semester		
Required Course		6
ARC 503	Advanced Architectural Design (Series)	
Architecture Elective		3
ARC 697	Final Project Research in Architecture [2]	
Architecture / College of Design Elective		3
	Hours	**12**
Spring Semester		
Required Course		6
ARC 503 or ARC 598	Advanced Architectural Design (Series) or Final Project Studio In Architecture	
Architecture Elective		3
Architecture / College of Design Elective		3
	Hours	**12**
	Total Hours	**48**

1. Architecture Electives: 24 credits must include ARC 561 The Practice of Architecture and may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.
2. If the faculty approves the student to undertake a Final Project, the student must take ARC 697 Final Project Research in Architecture as 3 credits of Architecture Elective and will substitute ARC 598 Final Project Studio In Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.

Track 3 Degree Requirements

Track 3 is for students without a preprofessional degree in architecture from a National Architecture Accrediting Board (NAAB) accredited program.

Code	Title	Hours	Counts towards
Required Coursework			
Undergraduate Coursework		51	
Graduate Coursework		45	
Total Hours		**96**	

Undergraduate Coursework

Code	Title	Hours	Counts towards
Required Undergraduate Courses		**51**	
ARC 450	Architectural Drawing		
ARC 451	Digital Representation		
ARC 403	Architectural Design Fundamentals: Environment		
ARC 211	Natural Systems and Architecture		
ARC 241	History of World Architecture		

ARC 404	Architectural Design Fundamentals: Form	
ARC 232	Structures and Materials	
ARC 242	History of Western Architecture	
ARC 405	Architectural Design Fundamentals: Technology	
ARC 331	Architectural Structures I	
ARC 432	Architectural Construction Systems	
ARC 441	History of Contemporary Architecture	
ARC 332	Architectural Structures II	
ARC 414	Environmental Control Systems	

Graduate Coursework

Code	Title	Hours	Counts towards
Required Graduate Courses		**24**	
ARC 500	Architectural Design: Professional Studio		
ARC 503	Advanced Architectural Design (Series) [1,2]		
or ARC 598	Final Project Studio In Architecture		
Architecture Electives / College of Design Electives		**21**	
ARC 561	The Practice of Architecture [3]		
ARC 697	Final Project Research in Architecture [2]		
Select "Architecture Electives" and a maximum of six hours or "College of Design" electives to meet a total of 21 hours [4]			

1 The studio assignment will be determined by the School of Architecture prior to the semester start.

2 If the faculty approves the student to undertake a Final Project, the student will substitute ARC 598 Final Project Studio In Architecture for the last semester ARC 503 Advanced Architectural Design (Series) requirement and must take ARC 697 Final Project Research in Architecture as 3 credits of the "Architecture Electives".

3 ARC 561 The Practice of Architecture must be taken and counts toward the ARC Elective credits. This course can be taken any semester that ARC Electives appear in the curriculum.

4 College of Design Electives include courses offered within the College of Design with ADN, D, DDN, GD, ID, LAR course prefixes 400-level and above.

Semester Sequence

First Year

Summer		**Hours**
Required Courses		6
ARC 450	Architectural Drawing [5]	
ARC 451	Digital Representation [5]	
	Hours	**6**
	Total Hours	**6**

First Year

Fall Semester		**Hours**
Required Courses		12
ARC 403	Architectural Design Fundamentals: Environment	
ARC 211	Natural Systems and Architecture	
ARC 241	History of World Architecture	
	Hours	**12**
Spring Semester		
Required Courses		12
ARC 404	Architectural Design Fundamentals: Form	
ARC 232	Structures and Materials	
ARC 242	History of Western Architecture	
	Hours	**12**

Second Year

Fall Semester		
Required Courses		15
ARC 405	Architectural Design Fundamentals: Technology	
ARC 331	Architectural Structures I	
ARC 432	Architectural Construction Systems	
ARC 441	History of Contemporary Architecture	
	Hours	**15**
Spring Semester		
Required Courses		12
ARC 500	Architectural Design: Professional Studio	
ARC 332	Architectural Structures II	
ARC 414	Environmental Control Systems	
Architecture / College of Design Elective [6]		3
	Hours	**15**

Third Year

Fall Semester		
Required Course		6
ARC 503	Advanced Architectural Design (Series)	
Architecture / College of Design Electives [6]		6
	Hours	**12**

Spring Semester		
Required Course		6
ARC 503	Advanced Architectural Design (Series)	
Architecture Elective [6]		3
ARC 697	Final Project Research in Architecture [7]	
Architecture / College of Design Elective [6]		3
	Hours	**12**
Fourth Year		
Fall Semester		
Required Course		6
ARC 503 or ARC 598	Advanced Architectural Design (Series) [7] or Final Project Studio In Architecture	
Architecture Elective [6]		3
Architecture / College of Design Elective [6]		3
	Hours	**12**
	Total Hours	**90**

[5] ARC 450 Architectural Drawing and ARC 451 Digital Representation are typically offered during Summer Session II. When need by the School, ARC 450 may be offered Fall, first semester, and ARC 451 Spring, second semester.

[6] Architecture Electives: 24 credits must include ARC 561 The Practice of Architecture and may include 6 credits taken from 400 level or above courses offered within the College of Design with LAR, ID, GD, or A+D prefixes. ARC courses must be at the 500 level or above.

[7] If the faculty approves the student to undertake a Final Project, the student must take ARC 697 Final Project Research in Architecture as 3 credits of Architecture Elective and will substitute ARC 598 Final Project Studio In Architecture for the ARC 503 Advanced Architectural Design (Series) in the last semester.

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Architecture (MR): History and Theory of Architecture Concentration

Concentration Requirements

Concentration students are required to complete a minimum of 12 hours of approved courses in the History and Theory of Architecture within the existing curricula of the Master of Architecture (Tracks 1, 2, and 3) degrees.

Code	Title	Hours	Counts towards
Primary Courses		**3**	
Select one or both of the following Primary Courses:			
ARC 540	Architectural Theory		
or ARC 545	Methods of Interpretation in Architectural History		
Secondary Courses		**9**	
ARC 530	Tectonics and Craft		
ARC 535	Experiments in Architecture Prototypes		

ARC 541	Architecture, Culture, and Meaning	
ARC 542	Sacred Architecture	
ARC 543	Analysis of Precedent	
ARC 544	American City Planning History	
ARC 572	Regional Infrastructures	
ARC 590	Special Topics in Architecture (The Ontology of Home)	
ARC 590	Special Topics in Architecture (New Taxonomies for Modernity)	
ARC 590	Special Topics in Architecture (Mediterranean Cities)	
ARC 590	Special Topics in Architecture (Architecture and Modernity)	
ARC 590	Special Topics in Architecture (Networks of Architecture and Development)	
ARC 590	Special Topics in Architecture (Beyond the Bauhaus)	
ARC 590	Special Topics in Architecture (Latin American Architecture)	
ARC 590	Special Topics in Architecture (Laws of the Indies)	
ARC 590	Special Topics in Architecture (Inca and Spanish Cuzco)	
ARC 590	Special Topics in Architecture (Luis Barragán)	
ARC 590	Special Topics in Architecture (The City of New Orleans)	
ARC 590	Special Topics in Architecture (Triangle Modernism)	
Total Hours		**12**

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Advanced Architectural Studies (MR)

Degree Requirements

All degrees will be distributed as "Master of Advanced Architectural Studies" without focus area specifications.

This degree is not accredited by the National Architecture Accrediting Board (NAAB).

Code	Title	Hours	Counts towards
Required Courses		**15**	
ARC 682	Directed Research		
ARC 698	Advanced Architectural Studies Project		
Elective Courses		**15**	
Select a minimum of 6 hours of "Architecture Electives"			
Select a minimum of 9 hours of electives within a focus area			
Total Hours		**30**	

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Architecture (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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City Design (Certificate)

The Graduate Certificate in City Design is a joint program between the School of Architecture and the Department of Landscape Architecture. The certificate program promotes design inquiry and application at the scale of the city for students and practitioners of architecture and landscape architecture. The program's objectives are to consider the human condition, particularly in making signification urban places; design integrated systems of movement with increased accessibility; promote a greater mix of uses and amenities within a well-scaled urban fabric; foster new opportunities for energy production at the local scale; define new means of 'greening' the city; and capture greater senses of identity, meaning, and quality within the city fabric.

Admissions Requirements

Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the certificate program, students must be enrolled in a professional program in architecture or landscape architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

Degree Requirements

Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than B-. Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for 'credit only' if they intend for the course to be part of the graduate certificate. Transfer credit from other institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school.

Plan Requirements

Certificate students are expected to complete a total of 15 hours of coursework. There are three methods of fulfilling this requirement:

- one studio option;
- two studio option;
- no studio option.

Studios must be approved by the certificate coordinator in advance, as to whether they fulfill all, or a majority of the intentions of the certificate program.

Certificates earned will be distributed as: "Graduate Certificate in City Design" without studio option specifications.

Code	Title	Hours	Counts towards
Required Courses		**9**	
ARC 570	Anatomy of the City		
ARC 503	Advanced Architectural Design (Series)		
or LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
Elective Courses		**6**	
Select at least two courses from the following:			

School of Architecture Courses		
ARC 544	American City Planning History	
ARC 571	Urban House	
ARC 572	Regional Infrastructures	
ARC 574	Place and Place Making	
ARC 575 Participatory Design in Architecture – course pending Admin Board Approval 2021		
ARC 576	Community Design	
ARC 577	Sustainable Communities	
ARC 589	Architectural Travel Study II [1]	
ARC 590	Special Topics in Architecture	
ARC 630	Independent Study [1]	
Department of Landscape Architecture Courses		
LAR 535	Environmental Social Equity and Design	
LAR 542	Human Use of the Urban Landscape	
LAR 545	City Planning and Design - Building Great Communities	
LAR 582	Special Topics In Landscape Architecture (Intro to Environment and Behavior for Designers)	
LAR 582	Special Topics In Landscape Architecture [1]	
LAR 630	Independent Study [1]	
Total Hours		**15**

[1] Requires approval of certificate coordinator

Energy and Technology in Architecture (Certificate)

The Graduate Certificate in Energy and Technology in Architecture provides students the opportunity to focus their elective studies through courses and design studio(s) that concentrate on building energy systems along with other building systems.

The program's objectives are to provide educational opportunities for architecture graduate students who wish to acquire knowledge and skills in the design and operation of building system at site and building levels, with an emphasis on energy and materials; to advocate for the importance of energy efficiency over the entire life cycle of a building; and to make our students more competitive in the fields of architectural practice, building engineering, and construction.

This certificate program also provides unique interdisciplinary academic and research opportunities among the College of Design, programs within the College of Engineering, NC Solar Center, and building design industries/organizations (i.e. architecture, engineering, general contracting, real estate companies, and public policy agencies).

Admissions

Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the graduate certificate in Energy and Technology in Architecture, students must be enrolled in (or have completed) a professional program in architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

Requirements

Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than B-. Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for 'credit only' if they intend for the course to be part of the graduate certificate. Transfer credit from other institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school.

A student may obtain more than one certificate. Each certificate must have a least nine (9) credit hours that are unique to it.

Other Information

Students in this certificate program will become part of an academic and professional community that offers a broad range of extracurricular activities, including the NC Solar Center GreenBuild Lecture Series, visiting lecturers, and colloquia.

Note that academic success might have a strong bearing on admission to a degree program, but completion of the certificate program in no way guarantees entry into a graduate degree program. For more information regarding course requirements and the application process, please contact the certificate program coordinator.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
ARC 503	Advanced Architectural Design (Series)		
ARC 697	Final Project Research in Architecture [1]		
Elective Courses		**6**	
See "Elective Courses" listed below			
Total Hours		**15**	

[1] Students have the option to take a third elective course from "Elective Courses" listed below.

Elective Courses

Code	Title	Hours	Counts towards
Select at least two courses from the lists below:		**6**	
Approved Focus Studios Courses			
ARC 503	Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)	6	
ARC 503	Advanced Architectural Design (Series) (Airport Design)	6	
ARC 503	Advanced Architectural Design (Series) (High-rise Building Design)	6	
ARC 503	Advanced Architectural Design (Series) (Production for Architecture)	6	
Approved Focus Elective Courses			
ARC 520	Sustainable Architecture	3	
ARC 521	Daylighting and Passive Energy Systems for Architecture	3	
ARC 522	Building Energy Efficiency & Renewable Energy	3	
ARC 523	Building Energy Modeling and Simulation	3	
ARC 524	Building Energy Optimization	3	
ARC 530	Tectonics and Craft	3	
ARC 534	Design of Architectural Details	3	
ARC 535	Experiments in Architecture Prototypes	3	
ARC 536	Materials for Design	3	
ARC 537	Digital Materials Translations	3	
ARC 538	Manufacturing Architecture	3	
Electives Available per Certificate Coordinator Approval			
CE 504	Airport Planning and Design	3	
HI 540	American Environmental History	3	
HI 585	History of American Technology	3	
ID 500	Advanced Industrial Design (Series)	6	
ID 511	Industrial Design Materials and Processes I	3	
ID 512	Industrial Design Materials and Processes II	3	
ID 582	Special Topics In Industrial Design	1-6	
MAE 589	Special Topics In Mechanical and Aerospace Engineering	1-6	
MSE 556	Composite Materials	3	
MSE 576	Technology Entrepreneurship and Commercialization I	3	
MSE 577	Technology Entrepreneurship and Commercializatior II	3	

ETA Certificate Course Structure

Certificate students are required to take at least one course in each of the above two categories to achieve the learning outcomes defined for the program.

Code	Title	Hours	Counts towards
Energy-Focused Courses			
ARC 503	Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)	6	
ARC 503	Advanced Architectural Design (Series) (Airport Design)	6	
ARC 520	Sustainable Architecture	3	
ARC 521	Daylighting and Passive Energy Systems for Architecture	3	
ARC 522	Building Energy Efficiency & Renewable Energy	3	
ARC 523	Building Energy Modeling and Simulation	3	
ARC 524	Building Energy Optimization	3	
Material/Tectonic-Focused Courses			
ARC 503	Advanced Architectural Design (Series) (High-rise Building Design)	6	
ARC 503	Advanced Architectural Design (Series) (Production for Architecture)	6	
ARC 530	Tectonics and Craft	3	
ARC 536	Materials for Design	3	
ARC 537	Digital Materials Translations	3	
ARC 538	Manufacturing Architecture	3	
ARC 534	Design of Architectural Details	3	
ARC 535	Experiments in Architecture Prototypes	3	

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Public Interest Design (Certificate)

Plan Requirements

The Graduate Certificate in Public Interest Design is divided into three options based on design and studio courses.

Certificates earned will be distributed as: "Graduate Certificate in Public Interest Design" without course option specifications.

Option One

Code	Title	Hours	Counts towards
Required Course		**3**	
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues		
Design Studio Courses		**12**	
See "Design Studio Courses" listed below			
Total Hours		**15**	

Option Two

Code	Title	Hours	Counts towards
Required Course		**3**	
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues		
Design Studio Course		**6**	

See "Design Studio Courses" listed below	
Seminar Courses	**6**
See "Seminar Courses" listed below	
Total Hours	**15**

Option 3

Code	Title	Hours	Counts towards
Required Course			
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues	3	
Seminar Courses		**12**	
See "Seminar Courses" listed below			
Total Hours		**15**	

Design Studio Electives

Code	Title	Hours	Counts towards
LAR 500	Landscape Design Studio	6	
ARC 503	Advanced Architectural Design (Series) (Affordable Housing Studio)	6	
ARC 503/563	Advanced Architectural Design (Series) (PID Incubator Studio)	6	
ARC 503	Advanced Architectural Design (Series) (Coastal Dynamics Studio)	6	
ARC 503	Advanced Architectural Design (Series) (Design Build Summer Studio)	6	
LAR 582	Special Topics In Landscape Architecture (Coastal Dynamics Studio)	6	

Seminar Electives

Code	Title	Hours	Counts towards
LAR 582	Special Topics In Landscape Architecture (Introduction to Research Methods)	3	
LAR 582	Special Topics In Landscape Architecture (Human Centered Design)	3	
ID 582	Special Topics In Industrial Design (Human Centered Design)	3	
ARC 590	Special Topics in Architecture (DIY Cartography)	3	
or ADN 592	Graduate Art + Design Special Topics		
ARC 590	Special Topics in Architecture	3	
LAR 582	Special Topics In Landscape Architecture	3	
ADN 502	Graduate Art + Design Laboratory (Documentary Film)	3	

Public Administration Seminar Electives

Code	Title	Hours	Counts towards
PA 510	Public Administration Institutions and Values	3	
PA 512	The Budgetary Process	3	
PA 521	Government and Planning	3	
PA 535	Problem Solving for Public and Nonprofit Managers	3	
PA 536	Management of Nonprofit Organizations	3	
PA 546	Seminar in Program Evaluation	3	
PA 553	Disaster, Crisis and Emergency Management and Policy	3	
PA 598	Special Topics in Public Administration (Grant Writing and Management)	3	

Art and Design

The Art and Design program offers an educational structure that creates a new art and design professional: one for whom artistic and practical talents are developed as different expressions of individual potential. Our objectives are to graduate highly educated art and design professionals with integrated competencies in art, design, aesthetics, theory, hand and digital technologies, design process, and the combination of skills in the chosen concentration with other disciplines of human knowledge.

Admission Requirements

Students will be required to submit a portfolio of past work in electronic format; three letters of recommendation; a statement of personal goals; and transcripts of undergraduate work (minimum undergraduate GPA of 3.0). An interview will be required, but in cases of international applicants or those quite distant from NC State University, may be conducted by means of a long distance phone conversation or may be waived at the faculty's discretion.

Masters Degree Requirements

The program of study requires a minimum of 48 credit hours of graduate work depending on background preparation of the applicant. Separate tracks of 60 and 72 credit hours accommodate students changing design disciplines or with insufficient background in the chosen concentration.

Other Information

We will only admit students to the program in the fall semester each year. Deadline for application is January 5.

Degrees

- Art and Design (MR) (p. 246)

Faculty

Full Professors

Chandra D Cox

Hernan Marchant

J. Mark Scearce

Associate Professors

Tania Leigh Allen

Patrick J Fitzgerald

Derek Ham

Kathleen Callahan Rieder

Marc Ernest Russo

Assistant Professors

Todd Michael Berreth

Katherine Celia Greder

Justin Johnson

Emeritus Faculty

Susan D. Brandeis

Charles Edward Joyner

Vita Karina Plume

Dana Gordon Raymond

Susan Margaret Toplikar

Lecturers

Kirby Steele Culbertson

Lesley-Ann Melanie Noel

Research Associates

William L Cherry

Art and Design (MR)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area:

- Track 1 (p. 246)
- Track 2 (p. 247)
- Track 3 (p. 248)

Degrees earned will be distributed as: "Master of Art and Design" without track specifications.

Track 1

Code	Title	Hours	Counts towards
Core Courses		**21**	
ADN 570	Graduate Studio III: Final Project Definition		
ADN 510	Graduate Seminar III: Final Project Research		
ADN 571	Graduate Studio IV: Final Project Development		
ADN 511	Graduate Seminar IV: Final Project Documentation		
Elective Courses		**9**	

Select a minimum of nine hours of coursework from the following courses:

ADN 502	Graduate Art + Design Laboratory	
ADN 592	Graduate Art + Design Special Topics	
ADN 630	Graduate Art + Design Independent Study	
ADN 685	Supervised Teaching	
Total Hours		**30**

Optional Additional Coursework

Code	Title	Hours	Counts towards
Select up to twelve credit hours of the following coursework approved in conjunction with the academic committee:		**0-12**	
ADN 502	Graduate Art + Design Laboratory (Specialized Electives)		
ADN 571	Graduate Studio IV: Final Project Development		
ADN 688	Non-Thesis Masters Continuous Registration - Half Time Registration		
ADN 689	Non-Thesis Master Continuous Registration - Full Time Registration		
Total Hours		**30-42**	

Track 2

Code	Title	Hours	Counts towards
Core Courses		**39**	
ADN 500	Graduate Seminar I: Software, Platforms + Environments		
ADN 560	Graduate Studio I: Immersive and Experimental Narratives		
ADN 501	Graduate Seminar II: Art + Design as Future Making		
ADN 561	Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation		
ADN 570	Graduate Studio III: Final Project Definition		
ADN 510	Graduate Seminar III: Final Project Research		
ADN 571	Graduate Studio IV: Final Project Development		
ADN 511	Graduate Seminar IV: Final Project Documentation		
Elective Courses		**9**	
Select a minimum of nine hours of coursework from the list below:			
ADN 502	Graduate Art + Design Laboratory		
ADN 592	Graduate Art + Design Special Topics		
ADN 630	Graduate Art + Design Independent Study		
ADN 685	Supervised Teaching		
Total Hours		**48**	

Optional Additional Courses

Code	Title	Hours	Counts towards
Select up to twelve hours of the following coursework approved in conjunction with the academic committee:		**0-12**	
ADN 571	Graduate Studio IV: Final Project Development		
ADN 688	Non-Thesis Masters Continuous Registration - Half Time Registration		

ADN 689	Non-Thesis Master Continuous Registration - Full Time Registration	
ADN 502	Graduate Art + Design Laboratory (Specialized Electives)	
Total Hours		**48-60**

Track 3

Code	Title	Hours	Counts towards
Core Courses		**36**	
ADN 500	Graduate Seminar I: Software, Platforms + Environments		
ADN 501	Graduate Seminar II: Art + Design as Future Making		
ADN 510	Graduate Seminar III: Final Project Research		
ADN 511	Graduate Seminar IV: Final Project Documentation		
ADN 560	Graduate Studio I: Immersive and Experimental Narratives		
ADN 561	Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation		
ADN 570	Graduate Studio III: Final Project Definition		
ADN 571	Graduate Studio IV: Final Project Development		
Elective Courses		**12**	
Select a minimum of four courses below:			
ADN 502	Graduate Art + Design Laboratory		
ADN 592	Graduate Art + Design Special Topics		
ADN 630	Graduate Art + Design Independent Study		
ADN 685	Supervised Teaching		
Undergraduate Coursework [1]		**12-24**	
Total Hours		**60-72**	

[1] 2 credit hours 400-level studio, 12 credit hours electives

Faculty

Full Professors

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Research Associates

William L Cherry

Design

At the College of Design, NC State University, the mission of the Doctoral Programs in Design (comprising both the Ph.D. and D.Des. programs) is to improve the human condition through design research and scholarship. This mission is built in equal parts on the recognition of a fertile common ground among the design disciplines and on the need for specificity and depth within them.

The Doctor of Philosophy (Ph.D.) in Design program values a broad range of research interests. The aim of the Ph.D. in Design is to prepare students holding previous degrees in design disciplines to conduct research in the areas of: design for health and well-being; design for learning; design for sustainability; design and technology; design and the urban context; design methods; and design history and criticism.

The Doctor of Design (D.Des.) program provides distance-education opportunities for established design professionals to conduct original investigations using design practices, cases, and methods. D.Des. students pursue practice-based design research in support of professions creating the artifacts, communications, environments, and organizing systems of the future.

Both programs provide a forum for connecting design research to the needs of society, by promoting the application of new knowledge in design and addressing design impacts on larger systems.

Admission Requirements

For admission to both the Ph.D. and D.Des. programs, submit official transcripts from each earned undergraduate and graduate degrees (required); three letters of reference; TOEFL scores (for international students); residency statement (US residents only); College of Design personal data form; statement of research intent; and portfolio. GRE scores are required for all Ph.D. applicants. If reasoning and writing ability is clearly demonstrated through previous graduate degrees, or professional or academic work products and impact, D.Des. applicants may ask for a waiver of GRE scores.

Doctoral Degree Requirements

Both programs of study require a minimum of 54 credit hours of graduate work beyond the Master's degree.

Degrees

- Design (PhD) (p. 250)
- Design (DDes) (p. 251)

Faculty

Full Professors

Robin Fran Abrams

Thomas M. Barrie

Kofi Malik Boone

Chandra D. Cox

Denise M. Crisp

Margaret Elen Deming

Andrew Alan Fox

David Brian Hill

Mark Elison Hoversten

Sharon Melissa Bennett Joines

Tsailu Liu

Robin C. Moore

Wayne Place

J. Mark Scearce

Gavin Paul Smith

Associate Professors

Deepti Adlakha

Tania Leigh Allen

Helen Saunders Armstrong

Timothy W. Buie

Soolyeon Cho

George Elvin

Patrick J. Fitzgerald

Russell Alan Flinchum

Carolina Gill

Dana Kathleen Gulling

Derek Allen Ham

Jianxin Hu

Bryan Bell Jr.

Bryan W. Laffitte

Deborah K. Littlejohn

Fernando H. Magallanes

Patricia E Morgado

Sara Glee Queen

Kathleen Callahan Rieder

Kristen J. Schaffer

Assistant Professors

Todd Michael Berreth

Burak Erdim

Lesley-Ann Melanie Noel

Celen Pasalar

Matthew O. Peterson

Traci Rose Rider

Kelly Ann Umstead

Emeritus Faculty

Eugene H Bressler

Meredith Joy Davis

Haig Khachatoorian

Arthur R Rice

Paul Tesar

Practice/Research/Teaching Professors

Nilda Graciela Cosco

Emily Ryan McCoy

Marshall E. Purnell

Design (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**39**	
DDN 701	Research Methods in Design		
DDN 702	Research Paradigms in Design		
DDN 809	Dissertation Colloquium [1]		
Student must take an additional methods courses determined in conjunction with the academic committee			
Students must take a field foundation course determined in conjunction with the academic committee			
DDN 890	Doctoral Preliminary Examination [2]		
DDN 893	Doctoral Supervised Research		
DDN 895	Doctoral Dissertation Research		
Elective Courses		**33**	
"Elective Courses" that will be applied to reach 72 total hours will be determined in conjunction with the academic committee			
Total Hours		**72**	

1 Must take course 3 times

2 Not counted for graduation

Faculty

Full Professors

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Emily Ryan McCoy

Marshall E. Purnell

Design (DDes)

Degree Requirements

Code	Title	Hours	Counts towards
Level 1 Courses		**12**	
The following courses are required:			
DDN 740	Introduction to Practice-Based Design Research		
DDN 742	Design Practice Legacy as a Learning Endeavor		
or DDN 701	Research Methods in Design		
DDN 810	Special Topics (DDN 883 Directed Study [Workshop] Part I – pending Admin Board approval 2021)		
DDN 810	Special Topics (DDN 833 Directed Study [Workshop] Part II – pending Admin Board approval 2021)		
Level 2 Courses		**12**	
Select four courses of the following:			
DDN 741	Case Study Analysis in Design		
DDN 743	Design Practice Leadership and Ethics		
DDN 744	Design for Health and Wellbeing		
DDN 745	Design Innovation and Entrepreneurship		
Level 3 Courses		**15**	
Select two courses of the following:			
DDN 890	Doctoral Preliminary Examination		
DDN 893	Doctoral Supervised Research [1]		
Level 4 Courses		**18**	
DDN 895	Doctoral Dissertation Research [1]		

DDN 899	Doctoral Dissertation Preparation	
Total Hours		**57**

1 Students must take 12 total credit hours of DDN 893 Doctoral Supervised Research and 18 total credit hours of DDN 895 Doctoral Dissertation Research

Optional Elective

Code	Title	Hours	Counts towards
DDN 810	Special Topics (Topics vary)	1-6	

Faculty

Full Professors

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Nilda Graciela Cosco

Emily Ryan McCoy

Marshall E. Purnell

Graphic Design

Overview

The Masters of Graphic Design (MGD) program helps move the passionate student toward a deeper knowledge of graphic and experience design and purposeful, individually driven design practices. Inquiry into contemporary and emergent design issues prepares graduates of the program for leadership positions that both evolve the profession and advance the discipline. Successful completion of the MGD results in a terminal degree, equal to the MFA, and qualifies graduates to teach at the university level or to pursue a PhD in Design.

Faculty charge graduate students to closely examine the cultural and technological situatedness of graphic design and its products, and to seek understanding of the people who use and interact with the things that graphic designers make. Coursework acquaints students with relevant theories and design research methods that frame and ground the design of propositional visual communication systems.

Varied topics prompt students to explore contemporary design concerns: the cultural contexts of design, the influence and experiences of end users, the social and technological environments within which designed artifacts operate. Subtopics within these broad concerns allow faculty and students the opportunity to frame, research, and respond to current and future design challenges.

The MGD program is consistently recognized as one of the top NASAD accredited graduate graphic design programs in the country and one of the few with STEM Classification (CIP). The faculty is nationally and internationally recognized (see Faculty at a Glance). Alumni are designers in leading professional offices around the world, faculty members in colleges and universities throughout the US and Canada, and doctoral students in PhD programs worldwide.

Affordable NC State tuition usually makes the cost of attending NC State well below that of equivalent graduate institutions. For out-of-state students, North Carolina residency laws recognize graduate students as residents after their first year.

MGD II: Two-year Master of Graphic Design Program

The MGD II program targets applicants who have earned a BFA or equivalent in graphic design and are practiced in visual communication, user interaction design (UI), user experience design (UX) and/or related design fields.

Integrated graduate studios, seminars, and workshops expose students to histories, design-related theories, and research methods relevant to current and emerging practices. Students investigate questions individually and collaboratively around the design of communication and interaction in several ways: through making (visualizations, visual diagrams, and functioning prototypes, for instance); assigned and independent reading and research; discussion and critique; and writing. Students also enroll in at least one elective offered in the college, university, or our affiliate universities, Duke University and UNC, Chapel Hill.

Students create a body of work as they explore a research interest area within studio and seminar subtopics. The experience of creating this work, coupled with researching and writing, positions students to identify a design investigation in their final year, which culminates in the required Final Project. For this work, students comprehensively research an area of interest, design propositional artifacts (findings), document the research and findings in a written thesis, and present the project in a public forum.

MGD III: Three-year Master of Graphic Design Program

The MGD III program targets applicants who have some professional experience but who have not earned a first degree in graphic design or have earned a BA with a graphic design concentration. (Note that applicants aiming for a qualifying professional degree in graphic design should apply to the Bachelor of Graphic Design program.)

MGD III students enroll in two semesters of specialized and advanced undergraduate coursework prior to matriculating to the MGD II program. The curriculum includes two studio--based courses and at least two lecture/seminar courses. The 6 credit studios cover systems thinking in design for user experience, visual communication, and other professional graphic design topics while they prepare the student for graduate level inquiry. Additional three credit courses focus on subjects such as mobile interaction, typography, graphic design theory and history, coding and modeling for interface design.

Admissions Requirements

Applications for Priority Admission are due to the Graduate School by January 5. Applications are reviewed until all seats are filled. In addition to Graduate School requirements, the Department asks for department personal data forms, a written personal statement, and a website or accessible online PDF portfolio that demonstrates experience and skills in visual communication.

Degree Requirements

The MGD (II) degree requires successful completion of 48 total credits, however students typically take advantage of additional coursework during their time at NC State.

The core curriculum consists of a 9-credit studio and a 3-credit seminar -- either Design Methods, Design Frameworks, or Final Project Research -- in each of the first three semesters of study. Students are encouraged to augment their study during this time with 400 or 500 level design coursework that enhances skills and/or investigates topics of interest. For instance, the program offers seminars on Graphic Design Pedagogy, Design Discourse and Typography, and Special Topics in Social Innovation. Students are required to enroll in a 3-credit 400 or 500 level elective within another college at NC State or at nearby Duke University or UNC/Chapel Hill under NC State tuition. The fourth semester is devoted to the final project for 6 credits, under the supervision of three Graphic Design faculty members comprising each student's graduate committee.

Degrees

- Graphic Design (MR) (p. 254)

Faculty

Full Professors

Denise M. Crisp

Scott Townsend

Associate Professors

Helen Armstrong

Kermit L. Bailey

Russell Flinchum

Carolina Gill

Deborah K. Littlejohn

Tasheka Arceneaux Sutton

Assistant Professors

Jarrett Fuller

Emeritus Faculty

Meredith Joy Davis

Austin S. Lowrey

Martha Scotford

Graphic Design (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Graphic Design" without program length specifications.

Two Year Program

The MGD II program targets applicants who have earned a BFA or equivalent in graphic design and are practiced in visual communication, user interaction design (UI), user experience design (UX) and/or related design fields.

Code	Title	Hours	Counts towards
Required Courses		**39**	
GD 501	Designing Practices and Systems		
GD 502	Challenges in Information Design		
GD 572	Conceptual Frameworks for Designers		
GD 503	Technology and Design Futures		
GD 571	Research Methods in Design		
GD 573	New Information Environments		
GD 581	Final Project Definition		
Elective Course		**3**	
See "Elective Courses" listed below [1]			
Final Project		**6**	
GD 588	Final Project Investigation		
Total Hours		**48**	

[1] Elective Course requirement is met with any course listed within "Elective Courses" listed below, or a 400-level course within another college determined in conjunction with the academic committee.

Three Year Program

The MGD III program targets applicants who have some professional experience but who have not earned a first degree in graphic design or have earned a BA with a graphic design concentration.

Code	Title	Hours	Counts towards
Required Courses		**21**	
GD 500	Foundations of Graphic Design – course pending Admin Board approval 2021		
GD 592	Special Topics In Graphic Design (Tech Tinkering Seminar)		
GD 303	Graphic Design Theory and Practice		
GD 400	Advanced Graphic Design Studio		
GD 592	Special Topics In Graphic Design (Design Discourse and Typography)		
Elective Course		**3**	
See "Elective Courses" listed below			
Total Hours		**24**	

Elective Courses

Code	Title	Hours	Counts towards
GD 203	History of Graphic Design	3	
GD 317	Typographic Language, Writing, and Reading	3	
GD 417	Information and Publishing Design Systems	3	

GD 592	Special Topics In Graphic Design (Design Pedagogy)	1-6
GD 510	Imaging for Graphic Design IV	3
GD 517	Type IV	3

Faculty

Full Professors

Denise M. Crisp

Scott Townsend

Associate Professors

Helen Armstrong

Kermit L. Bailey

Russell Flinchum

Carolina Gill

Deborah K. Littlejohn

Tasheka Arceneaux Sutton

Assistant Professors

Jarrett Fuller

Emeritus Faculty

Meredith Joy Davis

Austin S. Lowrey

Martha Scotford

Industrial Design

Industrial Design is the professional service of creating and developing concepts and specifications that optimize the value, function and appearance of products and product systems to the mutual benefit of both user and manufacturer. This service is often provided in the context of a cooperative working relationship with other members of a development group.

Typical groups include management, marketing, engineering and manufacturing specialists. Industrial designers place special emphasis on human characteristics, needs and interests. These require particular understanding of visual, tactile, safety and convenience criteria. Industrial designers combine these considerations with practical concern for technical processes and requirements for manufacture; marketing opportunities and economic constraints; and distribution, sales and servicing arrangements. Industrial designers are guided by the awareness of their obligations to protect and promote public safety and well-being; to respect the environment; and to observe ethical business practices. Augmenting transdisciplinary practices, emerging areas of industrial design include design research and experience design.

Graduates with a Master of Industrial Design have career opportunities in four general areas; corporate design offices in manufacturing companies, design consulting firms, governmental agencies and educational institutions.

Admissions Requirements

Students must make application to the Department of Graphic Design and Industrial Design by January 5. In addition to Graduate School requirements, the Department requires department personal data forms, a digital portfolio of design work, resume, and a statement of intent. The GRE is required for students whose first degree is not in Industrial Design.

Master's Requirements

The Master of Industrial Design degree requires a minimum of

- 48 credit hours for applications with a Bachelor's degree in Industrial Design (Track II), or
- 78 credit hours for applications with Bachelor's degrees in an area other than Industrial Design (Track III).

The program generally does not accept transfer credits in lieu of required coursework at NC State. Studio credits presented for elective transfer must be accompanied by a portfolio of work from the courses under consideration.

Student Financial Support

The Department has limited provisions for tuition remission and assistantships. Assistantships are awarded on the basis of student and departmental needs. Assistantship requests should be made to the Department of Graphic Design and Industrial Design and should be submitted with the application for admission (for incoming students) or by advertised deadline (for continuing students).

Degrees

- Industrial Design (MR) (p. 256)

Faculty

Full Professors

Carolina Gill

Sharon Melissa Bennett Joines

Tsailu Liu

Bret Smith

Associate Professors

Timothy W. Buie

Russell Flinchum

Percy Rivera Hooper

Bongil Jin

Bryan W. Laffitte

Assistant Professors

Kelly Umstead

Emeritus Faculty

Vincent Foote

Haig Khachatoorian

Practice/Research/Teaching Professors

Kathryn Anne Wozniak

Industrial Design (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Industrial Design" without track specifications.

Track 2

Code	Title	Hours	Counts towards
Required Courses		**36**	
ID 500	Advanced Industrial Design (Series) (Human Centered Design Studio)		
ID 500	Advanced Industrial Design (Series) (Design Research Studio)		
ID 500	Advanced Industrial Design (Series) (Product Innovation Lab)		
ID 588	Final Project Studio In Industrial Design		
ID 512	Industrial Design Materials and Processes II		
ID 582	Special Topics In Industrial Design (Research Methods in Design)		
ID 581	Industrial Design Project Preparation		
ID 582	Special Topics In Industrial Design		
Elective Courses		**12**	
Students will select two design electives that will be determined in conjunction with the academic committee			
Students will select two design/ other electives that will be determined in conjunction with the academic committee			
Total Hours		**48**	

Track 3

Code	Title	Hours	Counts towards
Required Pre-Degree Coursework[1]			
ID 582	Special Topics In Industrial Design (Graduate Studio I)		
ID 582	Special Topics In Industrial Design (Production Digital Techniques I)		
ID 582	Special Topics In Industrial Design (Production Visualization I)		
ID 582	Special Topics In Industrial Design (Fabrication & Prototyping)		
ID 582	Special Topics In Industrial Design (Graduate Studio II)		
ID 582	Special Topics In Industrial Design (Product Digital Techniques II)		
ID 582	Special Topics In Industrial Design (Product Visualization II)		
ID 511	Industrial Design Materials and Processes I		
Required Courses		**36**	
ID 500	Advanced Industrial Design (Series) (Human Centered Design Studio)		

ID 500	Advanced Industrial Design (Series) (Design Research Studio)	
ID 500	Advanced Industrial Design (Series) (Product Innovation Lab)	
ID 588	Final Project Studio In Industrial Design	
ID 512	Industrial Design Materials and Processes II	
ID 581	Industrial Design Project Preparation	
ID 582	Special Topics In Industrial Design	
Elective Courses		**12**
Students will select two design electives that will be determined in conjunction with the academic committee		
Students will select two design/ other electives that will be determined in conjunction with the academic committee		
Total Hours		**48**

[1] Students are required to take 30 hours of pre-degree coursework. These courses will not be included on the Graduate Plan of Work.

Faculty

Full Professors

Carolina Gill

Sharon Melissa Bennett Joines

Tsailu Liu

Bret Smith

Associate Professors

Timothy W. Buie

Russell Flinchum

Percy Rivera Hooper

Bongil Jin

Bryan W. Laffitte

Assistant Professors

Kelly Umstead

Emeritus Faculty

Vincent Foote

Haig Khachatoorian

Practice/Research/Teaching Professors

Kathryn Anne Wozniak

Landscape Architecture

Course offerings or research facilities are available in the following areas: site planning and design, landscape history, urban public spaces, community design, regional design, resource management, outdoor learning environments, international urban and rural landscapes, and specialized landscapes.

Admission Requirements

The best-qualified applicants are accepted up to the maximum number of spaces that are available for new students. Exceptions to the minimum 3.00 GPA may be made for students with special backgrounds, abilities and interests.

Master's Degree Requirements

- Accredited First Professional Degree in Landscape Architecture: Candidates follow an 82-hour sequence of courses over a six-semester period. Three semesters of the program of study are determined by the required curriculum. The last three semesters of study are outlined by the student's Chair of the Department, Director of Graduate Programs, and/or advisor. Research and case studies lead to the final project and design application. The investigative direction is set in collaboration with the chair of the faculty committee. A formal presentation of findings to the faculty, student body and local professionals is required. The summary research and project report must be submitted to the College of Design faculty to meet the graduation requirements.
- Advanced Studies in Landscape Architecture: Candidates with an accredited undergraduate Landscape Architecture degree follow a 48-hour sequence of courses. Twenty-seven hours of electives are chosen through advising with the Director of Graduate Programs, advisors and faculty committee. Comprehensive research work is required for a final project with a final report is required. A formal presentation of findings to the faculty, student body and local professionals is also required.

Other Relevant Information

Students have the option of including a graduate minor in their course of studies. Minors can be in any other graduate program offered at NC State, UNC-CH and Duke University. Some examples of graduate minors are: natural resources, parks, recreation and tourism management, architecture, education, planning, civil engineering, and art and design. The College of Design includes the Center for Universal

Design, the Office of Research, Extension & Engagement, and the Natural Learning Initiative.

Degrees

- Landscape Architecture (MR) (p. 258)

Faculty

Full Professors

Kofi Malik Boone

Margaret Evans Calkins

Margaret Elen Deming

Andrew Alan Fox

Mark Elison Hoversten

Robin C. Moore

Gavin Paul Smith

Associate Professors

Deepti Adlakha

Carla F. Delcambre

Fernando H. Magallanes

Celen Pasalar

Julieta Trevino Sherk

Practice/Research/Teaching Professors

Madalyn Baldwin

Nilda Graciela Cosco

Charles Albert Flink

Emily Ryan McCoy

Rodney Leon Swink

Emeritus Faculty

Eugene H Bressler

Arthur Rice

Landscape Architecture (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Landscape Architecture" without track specifications.

Track 1

This curriculum is designed for graduate students with prior LAAB accredited degrees in landscape architecture.

Curriculum A

Code	Title	Hours	Counts towards
Studio Courses		**18**	
Select a minimum of three of the following:			
LAR 502	Site Design and Environmental Planning Studio		
LAR 503	Landscape Architecture Design Development & Construction Documentation Studio		
LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
LAR 697	Design Research Project Independent Study		
Seminar Courses		**30**	
Select a minimum of ten courses of the following:			
LAR 517	GIS Applications in Landscape Architecture and Environmental Planning		
LAR 520	Environment and Culture		
LAR 523	Landscape Architecture Plant Identification		
LAR 524	Planting Design Applications in Landscape Architecture		
LAR 527	Landform, Grading, and Environmental Site Systems		
LAR 528	Landscape Architecture Construction Materials and Methods		

LAR 582	Special Topics In Landscape Architecture (History of Landscape Architecture)
LAR 582	Special Topics In Landscape Architecture (Landscape Architecture Immersion)
LAR 534	Landscape Architecture Theory and Criticism
LAR 545	City Planning and Design - Building Great Communities
LAR 540	Research Methods in Landscape Architecture and Environmental Planning
LAR 550	Landscape Architecture Professional Practice
LAR 535	Environmental Social Equity and Design
LAR 543	Landscape Performance and Metrics
LAR 544	Contemporary Issues in Landscape Preservation
LAR 546	The Landscape Imperative
LAR 552	Survey of Natural Hazards and Disasters
LAR 554	Disaster Resilient Policy, Engineering and Design
LAR 582	Special Topics In Landscape Architecture (Sustainable Food Systems)
LAR 582	Special Topics In Landscape Architecture (Design Week)
LAR 582	Special Topics In Landscape Architecture (Advanced Digital Media)
LAR 582	Special Topics In Landscape Architecture (Sustainable Sites)
LAR 582	Special Topics In Landscape Architecture (Computational Design and Parametric Modeling)
LAR 582	Special Topics In Landscape Architecture (Introduction to Envt. and Behavior for Designers)
LAR 607	Natural Hazards, Disasters and Climate Change Adaptation Lecture Series
Total Hours	**48**

Curriculum B

Code	Title	Hours	Counts towards
Required Courses		**6**	
LAR 508	Landscape Architecture Design Research Project		
LAR 540	Research Methods in Landscape Architecture and Environmental Planning		
Additional Courses		**24**	
"Additional Courses" are determined in conjunction with the academic committee to meet the 30 total hours			
Total Hours		**30**	

Track 2

This LAAB Accredited curriculum is designed for graduate students with prior degrees in landscape architecture, architecture, or related design programs that are not LAAB accredited; also graduate students obtaining concurrent degrees in Architecture, Urban Design or Urban Planning.

Code	Title	Hours	Counts towards
Design Studio Sequence		**24-30**	
LAR 501	Landscape Architecture Introduction Design Studio		
or LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
LAR 502	Site Design and Environmental Planning Studio		
LAR 503	Landscape Architecture Design Development & Construction Documentation Studio		
LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning [1]		
LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
or LAR 697	Design Research Project Independent Study		
Representation and Modeling Sequence		**3**	
LAR 517	GIS Applications in Landscape Architecture and Environmental Planning		
Site Works Sequence		**13**	
LAR 520	Environment and Culture		
LAR 523	Landscape Architecture Plant Identification		
LAR 524	Planting Design Applications in Landscape Architecture		
LAR 527	Landform, Grading, and Environmental Site Systems		
LAR 528	Landscape Architecture Construction Materials and Methods		
History, Theory and Criticism Sequence		**12**	
LAR 582	Special Topics In Landscape Architecture (History of Landscape Architecture)		
LAR 582	Special Topics In Landscape Architecture (Landscape Architecture Immersion)		
LAR 534	Landscape Architecture Theory and Criticism		
LAR 545	City Planning and Design - Building Great Communities		
Research and Professional Practice Sequence		**6**	
LAR 540	Research Methods in Landscape Architecture and Environmental Planning		
LAR 550	Landscape Architecture Professional Practice		
Elective Courses		**6**	
LAR 535	Environmental Social Equity and Design		
LAR 543	Landscape Performance and Metrics		
LAR 544	Contemporary Issues in Landscape Preservation		
LAR 546	The Landscape Imperative		
LAR 552	Survey of Natural Hazards and Disasters		
LAR 554	Disaster Resilient Policy, Engineering and Design		
LAR 582	Special Topics In Landscape Architecture (Sustainable Food Systems)		

LAR 582	Special Topics In Landscape Architecture (Design Week)	
LAR 582	Special Topics In Landscape Architecture (Advanced Digital Media)	
LAR 582	Special Topics In Landscape Architecture (Sustainable Sites)	
LAR 582	Special Topics In Landscape Architecture (Computational Design and Parametric Modeling)	
LAR 582	Special Topics In Landscape Architecture (Introduction to Envt. and Behavior for Designers)	
LAR 607	Natural Hazards, Disasters and Climate Change Adaptation Lecture Series	
Total Hours		**64-70**

[1] May be waived

Track 3

The LAAB Accredited Track III curriculum is intended for graduate students with undergraduate degrees in fields other than landscape architecture, architecture or related design areas.

Code	Title	Hours	Counts towards
Design Studio Sequence		**36**	
LAR 501	Landscape Architecture Introduction Design Studio		
LAR 502	Site Design and Environmental Planning Studio		
LAR 503	Landscape Architecture Design Development & Construction Documentation Studio		
LAR 506	Landscape Architecture Design + Build Studio		
LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning [1]		
LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
or LAR 697	Design Research Project Independent Study		
Representation and Modeling Sequence		**6**	
LAR 514	Landscape Architecture Digital Design Media 2		
LAR 517	GIS Applications in Landscape Architecture and Environmental Planning		
Site Works Sequence		**13**	
LAR 520	Environment and Culture		
LAR 523	Landscape Architecture Plant Identification		
LAR 524	Planting Design Applications in Landscape Architecture		
LAR 527	Landform, Grading, and Environmental Site Systems		
LAR 528	Landscape Architecture Construction Materials and Methods		
History, Theory and Criticism Sequence		**12**	
LAR 582	Special Topics In Landscape Architecture (History of Landscape Architecture)		

LAR 582	Special Topics In Landscape Architecture (Landscape Architecture Immersion)	
LAR 534	Landscape Architecture Theory and Criticism	
LAR 545	City Planning and Design - Building Great Communities	
Research and Professional Practice Sequence		**6**
LAR 540	Research Methods in Landscape Architecture and Environmental Planning	
LAR 550	Landscape Architecture Professional Practice	
Elective Courses		**9**
Select at least three of the following courses:		
LAR 535	Environmental Social Equity and Design	
LAR 543	Landscape Performance and Metrics	
LAR 544	Contemporary Issues in Landscape Preservation	
LAR 546	The Landscape Imperative	
LAR 552	Survey of Natural Hazards and Disasters	
LAR 554	Disaster Resilient Policy, Engineering and Design	
LAR 582	Special Topics In Landscape Architecture (Sustainable Food Systems)	
LAR 582	Special Topics In Landscape Architecture (Design Week)	
LAR 582	Special Topics In Landscape Architecture (Advanced Digital Media)	
LAR 582	Special Topics In Landscape Architecture (Sustainable Sites)	
LAR 582	Special Topics In Landscape Architecture (Computational Design and Parametric Modeling)	
LAR 582	Special Topics In Landscape Architecture (Introduction to Envt. and Behavior for Designers)	
LAR 607	Natural Hazards, Disasters and Climate Change Adaptation Lecture Series	
Total Hours		**82**

Faculty

Full Professors

Kofi Malik Boone

Margaret Evans Calkins

Margaret Elen Deming

Andrew Alan Fox

Mark Elison Hoversten

Robin C. Moore

Gavin Paul Smith

Associate Professors

Deepti Adlakha

Carla F. Delcambre

Fernando H. Magallanes

Celen Pasalar

Julieta Trevino Sherk

Practice/Research/Teaching Professors

Madalyn Baldwin

Nilda Graciela Cosco

Charles Albert Flink

Emily Ryan McCoy

Rodney Leon Swink

Emeritus Faculty

Eugene H Bressler

Arthur Rice

Landscape Architecture (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Kofi Malik Boone

Margaret Evans Calkins

Margaret Elen Deming

Andrew Alan Fox

Mark Elison Hoversten

Robin C. Moore

Gavin Paul Smith

Associate Professors

Deepti Adlakha

Carla F. Delcambre

Fernando H. Magallanes

Celen Pasalar

Julieta Trevino Sherk

Practice/Research/Teaching Professors

Madalyn Baldwin

Nilda Graciela Cosco

Charles Albert Flink

Emily Ryan McCoy

Rodney Leon Swink

Emeritus Faculty

Eugene H Bressler

Arthur Rice

Disaster Resilient Policy, Engineering and Design (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**7**	
LAR 553	Natural Hazards, Disasters and Climate Change Adaptation Lecture Series – course pending Admin Board approval 2021		
LAR 554	Disaster Resilient Policy, Engineering and Design		
LAR 607	Natural Hazards, Disasters and Climate Change Adaptation Lecture Series		
Track Courses		**6**	
Select one of the focus tracks listed below			
Total Hours		**13**	

Policy Track

Code	Title	Hours	Counts towards
Select a minimum of two of the following courses in conjunction with the academic committee: [1]		**6**	
PA 553	Disaster, Crisis and Emergency Management and Policy		
PA 507	The Public Policy Process		
PA 511	Public Policy Analysis		
PA 798	Special Topics in Public Administration and Policy (Collaborative Governance and Public Networks)		
PA 550	Environmental Policy		
PA 546	Seminar in Program Evaluation		
PA 514	Management Systems		

1 Other PA courses as identified (including special topics, field study-see, for instance, firechasers program) subject to approval of instructor and track coordinator

Design Track

Code	Title	Hours	Counts towards
Select a minimum of two of the following courses in conjunction with the academic committee: [2]		**6**	
ARC 503	Advanced Architectural Design (Series) [3,4,5]		
or LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
LAR 545	City Planning and Design - Building Great Communities		
LAR 546	The Landscape Imperative		
LAR 535	Environmental Social Equity and Design		
LAR 547	Greenway Planning and Design		
LAR 520	Environment and Culture		
LAR 582	Special Topics In Landscape Architecture (Design for Resilient Food Systems)		
or ARC 590	Special Topics in Architecture		
LAR 582	Special Topics In Landscape Architecture		
LAR 630	Independent Study		
ARC 590	Special Topics in Architecture (Resilient Thinking)		
ARC 520	Sustainable Architecture		
ARC 548	Vernacular Architecture		
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues		
ARC 544	American City Planning History		
ARC 590	Special Topics in Architecture		

2 Other LAR and/or ARC courses as identified – subject to approval of instructor and track coordinator.

3 Subject to topical area and approval by the Certificate Coordinator.

4 Non-ARC/LAR students are subject to approval of studio instructors and these student may seek to take ARC 503/LAR 507 as a 3-credit hour course (focused on specific class sub-tasks that do not require design studio training/education).

5 ARC students are subject to a lottery to get into studios.

Construction, Civil and Environmental Engineering Track

Code	Title	Hours	Counts towards
Select a minimum of two of the following courses in conjunction with the academic committee: [6]		**6**	
CE 746	Soil Dynamics and Earthquake Engineering		
CE 581	Fluid Mechanics in Natural Environments		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)		

CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)
CE 567	Risk and Financial Management in Construction
CE 578	Energy and Climate
CE 583	Engineering Aspects Of Coastal Processes
CE 725	Earthquake Structural Engineering
CE 786	Hydroclimatology
CE 790	Advanced Topics In Civil Engineering
MEA 517	Fundamentals of Climate Change Science
MEA 593	Special Topics in Atmospheric Science (Fundamentals of Climate Change Science)
MEA 593	Special Topics in Atmospheric Science (Climate Risk Analysis for Adaptation)
MEA 519	Barriers to Climate Change Literacy
COM 538	Risk Communication
COM 579	Climate Change Communication
COM 566	Seminar In Crisis Communication

[6] Other CE courses as identified – subject to approval of instructor and track coordinator.

Graduate Certificates - College of Design

Certificates

- City Design (Certificate) (p. 241)
- Disaster Resilient Policy, Engineering and Design (Certificate) (p. 263)
- Energy and Technology in Architecture (Certificate) (p. 242)
- Public Interest Design (Certificate) (p. 244)

City Design (Certificate)

The Graduate Certificate in City Design is a joint program between the School of Architecture and the Department of Landscape Architecture. The certificate program promotes design inquiry and application at the scale of the city for students and practitioners of architecture and landscape architecture. The program's objectives are to consider the human condition, particularly in making signification urban places; design integrated systems of movement with increased accessibility; promote a greater mix of uses and amenities within a well-scaled urban fabric; foster new opportunities for energy production at the local scale; define new means of 'greening' the city; and capture greater senses of identity, meaning, and quality within the city fabric.

Admissions Requirements

Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the certificate program, students must be enrolled in a professional program in architecture or landscape architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

Degree Requirements

Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than B-. Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for 'credit only' if they intend for the course to be part of the graduate certificate. Transfer credit from other institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school.

Plan Requirements

Certificate students are expected to complete a total of 15 hours of coursework. There are three methods of fulfilling this requirement:

- one studio option;
- two studio option;
- no studio option.

Studios must be approved by the certificate coordinator in advance, as to whether they fulfill all, or a majority of the intentions of the certificate program.

Certificates earned will be distributed as: "Graduate Certificate in City Design" without studio option specifications.

Code	Title	Hours	Counts towards
Required Courses		**9**	
ARC 570	Anatomy of the City		
ARC 503	Advanced Architectural Design (Series)		
or LAR 507	Advanced Topics Studio in Landscape Architecture and Environmental Planning		
Elective Courses		**6**	
Select at least two courses from the following:			
School of Architecture Courses			
ARC 544	American City Planning History		
ARC 571	Urban House		
ARC 572	Regional Infrastructures		
ARC 574	Place and Place Making		
ARC 575 Participatory Design in Architecture – course pending Admin Board Approval 2021			
ARC 576	Community Design		
ARC 577	Sustainable Communities		
ARC 589	Architectural Travel Study II [1]		
ARC 590	Special Topics in Architecture		
ARC 630	Independent Study [1]		
Department of Landscape Architecture Courses			
LAR 535	Environmental Social Equity and Design		
LAR 542	Human Use of the Urban Landscape		
LAR 545	City Planning and Design - Building Great Communities		
LAR 582	Special Topics In Landscape Architecture (Intro to Environment and Behavior for Designers)		
LAR 582	Special Topics In Landscape Architecture [1]		
LAR 630	Independent Study [1]		
Total Hours		**15**	

[1] Requires approval of certificate coordinator

Energy and Technology in Architecture (Certificate)

The Graduate Certificate in Energy and Technology in Architecture provides students the opportunity to focus their elective studies through courses and design studio(s) that concentrate on building energy systems along with other building systems.

The program's objectives are to provide educational opportunities for architecture graduate students who wish to acquire knowledge and skills in the design and operation of building system at site and building levels, with an emphasis on energy and materials; to advocate for the importance of energy efficiency over the entire life cycle of a building; and to make our students more competitive in the fields of architectural practice, building engineering, and construction.

This certificate program also provides unique interdisciplinary academic and research opportunities among the College of Design, programs within the College of Engineering, NC Solar Center, and building design industries/organizations (i.e. architecture, engineering, general contracting, real estate companies, and public policy agencies).

Admissions

Applicants must complete an application form to be considered for the certificate program. To qualify for admission to the graduate certificate in Energy and Technology in Architecture, students must be enrolled in (or have completed) a professional program in architecture. At the time of application, students must have a 3.00 grade point average (GPA) in their professional degree program.

Requirements

Students must complete 15 hours of coursework from the course menu, as specified in the certificate application, and have a minimum of 3.00 GPA on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than B-. Students who take letter-graded 400-, 500-, and 700-level courses do not have the option of taking the courses for 'credit only' if they intend for the course to be part of the graduate certificate. Transfer credit from other

institutions is not allowed for the graduate certificate. All course work must be registered through NC State University.

All certificate requirements must be completed within four (4) calendar years, beginning with the date that the student commences courses applicable to the certificate, unless a more restrictive time limit has been established by the program or academic college/school.

A student may obtain more than one certificate. Each certificate must have a least nine (9) credit hours that are unique to it.

Other Information

Students in this certificate program will become part of an academic and professional community that offers a broad range of extracurricular activities, including the NC Solar Center GreenBuild Lecture Series, visiting lecturers, and colloquia.

Note that academic success might have a strong bearing on admission to a degree program, but completion of the certificate program in no way guarantees entry into a graduate degree program. For more information regarding course requirements and the application process, please contact the certificate program coordinator.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
ARC 503	Advanced Architectural Design (Series)		
ARC 697	Final Project Research in Architecture [1]		
Elective Courses		**6**	
See "Elective Courses" listed below			
Total Hours		**15**	

[1] Students have the option to take a third elective course from "Elective Courses" listed below.

Elective Courses

Code	Title	Hours	Counts towards
Select at least two courses from the lists below:		**6**	
Approved Focus Studios Courses			
ARC 503	Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)	6	
ARC 503	Advanced Architectural Design (Series) (Airport Design)	6	
ARC 503	Advanced Architectural Design (Series) (High-rise Building Design)	6	
ARC 503	Advanced Architectural Design (Series) (Production for Architecture)	6	
Approved Focus Elective Courses			
ARC 520	Sustainable Architecture	3	
ARC 521	Daylighting and Passive Energy Systems for Architecture	3	
ARC 522	Building Energy Efficiency & Renewable Energy	3	
ARC 523	Building Energy Modeling and Simulation	3	
ARC 524	Building Energy Optimization	3	
ARC 530	Tectonics and Craft	3	
ARC 534	Design of Architectural Details	3	
ARC 535	Experiments in Architecture Prototypes	3	
ARC 536	Materials for Design	3	
ARC 537	Digital Materials Translations	3	
ARC 538	Manufacturing Architecture	3	
Electives Available per Certificate Coordinator Approval			
CE 504	Airport Planning and Design	3	
HI 540	American Environmental History	3	
HI 585	History of American Technology	3	
ID 500	Advanced Industrial Design (Series)	6	
ID 511	Industrial Design Materials and Processes I	3	

ID 512	Industrial Design Materials and Processes II	3
ID 582	Special Topics In Industrial Design	1-6
MAE 589	Special Topics In Mechanical and Aerospace Engineering	1-6
MSE 556	Composite Materials	3
MSE 576	Technology Entrepreneurship and Commercialization I	3
MSE 577	Technology Entrepreneurship and Commercializatior II	3

ETA Certificate Course Structure

Certificate students are required to take at least one course in each of the above two categories to achieve the learning outcomes defined for the program.

Code	Title	Hours	Counts towards
Energy-Focused Courses			
ARC 503	Advanced Architectural Design (Series) (Collaborative Design Studio: Architecture + Engineering)	6	
ARC 503	Advanced Architectural Design (Series) (Airport Design)	6	
ARC 520	Sustainable Architecture	3	
ARC 521	Daylighting and Passive Energy Systems for Architecture	3	
ARC 522	Building Energy Efficiency & Renewable Energy	3	
ARC 523	Building Energy Modeling and Simulation	3	
ARC 524	Building Energy Optimization	3	
Material/Tectonic-Focused Courses			
ARC 503	Advanced Architectural Design (Series) (High-rise Building Design)	6	
ARC 503	Advanced Architectural Design (Series) (Production for Architecture)	6	
ARC 530	Tectonics and Craft	3	
ARC 536	Materials for Design	3	
ARC 537	Digital Materials Translations	3	
ARC 538	Manufacturing Architecture	3	
ARC 534	Design of Architectural Details	3	
ARC 535	Experiments in Architecture Prototypes	3	

Faculty

Full Professors

Soolyeon Cho

David Hill

Wayne Place

Pat Rand

Associate Professors

Dana Gulling

Jianxin Hu

Assistant Professors

Traci Rider

Public Interest Design (Certificate)

Plan Requirements

The Graduate Certificate in Public Interest Design is divided into three options based on design and studio courses.

Certificates earned will be distributed as: "Graduate Certificate in Public Interest Design" without course option specifications.

Option One

Code	Title	Hours	Counts towards
Required Course		**3**	
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues		
Design Studio Courses		**12**	
See "Design Studio Courses" listed below			
Total Hours		**15**	

Option Two

Code	Title	Hours	Counts towards
Required Course		**3**	
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues		
Design Studio Course		**6**	
See "Design Studio Courses" listed below			
Seminar Courses		**6**	
See "Seminar Courses" listed below			
Total Hours		**15**	

Option 3

Code	Title	Hours	Counts towards
Required Course			
ARC 563	Public Interest Design Seminar: Case Studies and Current Issues	3	
Seminar Courses		**12**	
See "Seminar Courses" listed below			
Total Hours		**15**	

Design Studio Electives

Code	Title	Hours	Counts towards
LAR 500	Landscape Design Studio	6	
ARC 503	Advanced Architectural Design (Series) (Affordable Housing Studio)	6	
ARC 503/563	Advanced Architectural Design (Series) (PID Incubator Studio)	6	
ARC 503	Advanced Architectural Design (Series) (Coastal Dynamics Studio)	6	
ARC 503	Advanced Architectural Design (Series) (Design Build Summer Studio)	6	
LAR 582	Special Topics In Landscape Architecture (Coastal Dynamics Studio)	6	

Seminar Electives

Code	Title	Hours	Counts towards
LAR 582	Special Topics In Landscape Architecture (Introduction to Research Methods)	3	
LAR 582	Special Topics In Landscape Architecture (Human Centered Design)	3	
ID 582	Special Topics In Industrial Design (Human Centered Design)	3	
ARC 590	Special Topics in Architecture (DIY Cartography)	3	
or ADN 592	Graduate Art + Design Special Topics		
ARC 590	Special Topics in Architecture	3	
LAR 582	Special Topics In Landscape Architecture	3	
ADN 502	Graduate Art + Design Laboratory (Documentary Film)	3	

Public Administration Seminar Electives

Code	Title	Hours	Counts towards
PA 510	Public Administration Institutions and Values	3	
PA 512	The Budgetary Process	3	

PA 521	Government and Planning	3
PA 535	Problem Solving for Public and Nonprofit Managers	3
PA 536	Management of Nonprofit Organizations	3
PA 546	Seminar in Program Evaluation	3
PA 553	Disaster, Crisis and Emergency Management and Policy	3
PA 598	Special Topics in Public Administration (Grant Writing and Management)	3

College of Education

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Adult and Community College Education

The Adult and Community College Education program area is a unique program in its emphasis on serving the spectrum of both formal and informal adult learning organizations, and its inclusion of administrative, instructional and technology-related leadership within a practitioner preparation program. Based on a land-grant, Research Extensive University, the department reflects the tripartite commitment to quality instruction, research scholarship and service outreach. It is one-of-a-kind as its primary commitment is to part-time students who are full-time working professionals. Full-time students are eligible for consideration to receive full funding through scholarships, fellowships and research and teaching assistantships, which allow our students to work with top faculty on cutting-edge projects. To meet the needs of full- and part-time students, most courses are offered once a week during late afternoon or evening hours. Some courses are regularly available during summer sessions and weekends and through distance education technologies.

Admission Requirements

Applications for admission are submitted through the Graduate School, accepted year-round and are applicable for the first available term. We accept students from a wide range of disciplinary backgrounds. To qualify for admission, applicants must have a bachelor's degree from an accredited institution of higher education in any field. International applicants must also have a TOEFL score of 100 or higher. Admission decisions are based on several criteria, including undergraduate GPA, work history and interest in the field.

Student Financial Support

To be eligible for financial aid, students must be enrolled in Master's or Doctoral degree programs offered by the University. Unfortunately there is no financial aid available for Graduate Certificate students. Occasionally graduate assistantships are available for full time students in our degree programs. Please check with your advisor about assistantship opportunities. We recommend that you contact the Office of Scholarships and Financial Aid to find out what other options are available.

Degrees

- Adult and Community College Education (MEd) (p. 272)
- Adult and Community College Education (MS) (p. 274)
- Community College Leadership (EdD) (p. 276)
- Adult & Community College Education (Minor) (p. 278)

Faculty

Duane Akroyd
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Stelfanie Williams
Area of Research: Community College Leadership

Adult and Community College Education (MEd)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area:

- Adult and Continuing Professional Education Track (p. 272)
- Community College Teaching Track (p. 273)
- Health Professions Education Track (p. 273)

Degrees earned will be distributed as: "Master of Education in Adult and Community College Education" without focus area track specifications.

Adult and Continuing Professional Education Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 559	The Adult Learner	3	
EAC 539	Teaching in the Online Environment	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 708	Continuing Education for the Professions	3	
or EAC 700	Community College and Two-Year Postsecondary Education		
Select 12 hours of Specialization credits		12	
EAC 551	Research in Adult & Higher Education	3	
EAC 692	Research Projects In Education	3	
or EAC 651	Internship In Adult and Community College Education		
Total Hours		**36**	

Community College Teaching Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 703	The Programming Process In Adult and Community College Education	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
Select 15-18 credit hours of specialization		15-18	
EAC 551	Research in Adult & Higher Education	3	
EAC 692	Research Projects In Education	3	
Total Hours		**33-36**	

Health Professions Education Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 559	The Adult Learner	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 539	Teaching in the Online Environment	3	
EAC 708	Continuing Education for the Professions	3	
EAC 532	Health Care Delivery Systems and Environments	3	
EAC 536	Issues and Trends In Education For the Health Professions	3	
Select six credit hours of Specialization Electives		6	
EAC 551	Research in Adult & Higher Education	3	
EAC 692	Research Projects In Education	3	
Total Hours		**36**	

Faculty

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Area of Research: Adult, Workforce, and Continuing Professional Education

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Saundra Williams
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Stelfanie Williams
Area of Research: Community College Leadership

Adult and Community College Education (MS)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area:

- Adult and Continuing Professional Education Track (p. 274)
- Community College Teaching Track (p. 275)
- Health Professions Education Track (p. 275)

Degrees earned will be distributed as: "Master of Science in Adult and Community College Education" without focus area track specifications.

Adult and Continuing Professional Education Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 559	The Adult Learner	3	
EAC 539	Teaching in the Online Environment	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 708	Continuing Education for the Professions	3	
or EAC 700	Community College and Two-Year Postsecondary Education		

Select a minimum of six credit hours of Specialization		6
Select a minimum of nine credit hours of Research		9
EAC 695	Master's Thesis Research	6
Total Hours		**39**

Community College Teaching Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 559	The Adult Learner	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 539	Teaching in the Online Environment	3	
EAC 700	Community College and Two-Year Postsecondary Education	3	
Select 18-24 credit hours of Academic Discipline Focus		18-24	
Select six credit hours of Research Methods		6	
EAC 695	Master's Thesis Research	6	
Total Hours		**48-54**	

Health Professions Education Track

Code	Title	Hours	Counts towards
Core Courses			
EAC 730	Foundations of Adult, Higher, and Human Res Education	3	
or EAC 522	Foundations of Adult Education		
EAC 559	The Adult Learner	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 539	Teaching in the Online Environment	3	
EAC 708	Continuing Education for the Professions	3	
EAC 532	Health Care Delivery Systems and Environments	3	
EAC 536	Issues and Trends In Education For the Health Professions	3	
Select a minimum of three credit hours of Specialization Electives		3	
Select a minimum of six credit hours of Research Component		6	
EAC 695	Master's Thesis Research	6	
Total Hours		**39**	

Faculty

Duane Akroyd
Area of Research: Adult, Workforce, and Continuing Professional Education

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Community College Leadership (EdD)

Degree Requirements

All doctoral degrees in the College of Education require a minimum of 72 graduate credit hours beyond the bachelor's degree. Most doctoral programs in the College of Education require a minimum of 60 graduate credit hours beyond an approved master's degree.

Thematic Research Areas

Select from the following six areas in which to conduct research:

- Completion and Transfer
- Learning Outcomes
- Equity
- Labor Market Outcomes
- Technology
- Culture/Organizational Behavior

Degrees earned will be distributed as: "Doctor of Education" without area of study or research specifications.

Code	Title	Hours	Counts towards
Core Courses		**27**	
EAC 700	Community College and Two-Year Postsecondary Education		
EAC 701	Administrative Concepts and Theories Applied To Adult and Community College Educ		

EAC 703	The Programming Process In Adult and Community College Education	
EAC 704	Leadership In Higher and Community College Education	
EAC 711	Reflective Practice and Research Inquiry	
EAC 712	The Change Process in Adult Education	
EAC 787	Organizational Theories and Concepts in Higher Education	
EAC 795	Topical Problems in Adult and Community College Education	
EAC 802	Seminar In Adult and Higher Education	
Practice-Based Research		**12**
EAC 788	Applied Qualitative Data Analysis	
EAC 803	Research Seminar in Adult and Higher Education (Methods I)	
EAC 803	Research Seminar in Adult and Higher Education (Methods II)	
EAC 824	Topical Problems In Adult and Higher Education	
Work-Based Learning Experience		**3**
EAC 851	Internship In Adult and Higher Education	
Dissertation		**12**
EAC 895	Doctoral Dissertation Research	
Additional Courses		**18**
"Additional Courses" will be approved in conjunction with the academic committee		
Total Hours		**72**

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Adult & Community College Education (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Clinical Mental Health Counseling

All master's degree programs (on-campus and online formats) are accredited by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024.

The doctoral program concentration in counseling and counselor education is accredited by the by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024

Admission Requirements

Admissions Requirements for Master's Programs (on-campus and online programs):

- Completed online application, resume, personal statement/goals, and non-refundable application fee
- We are no longer requiring the GRE Scores/MAT Scores for our masters program
- 3 recommendations from people who know your academic record and potential for graduate study (letters should be uploaded online)
- Official transcripts of all post-secondary education
- Official** statement of English Proficiency (TOEFL) for international students

Applicants are expected to have an undergraduate GPA of 3.0 or higher.

Master's Degree Requirements

For master's degree concentrations, admission is limited in order to maintain faculty student interaction in didactic classes, for supervision in practica and for informal contact. Generally, class size averages between 20 and 25 in didactic, 4-5 in practica, and the advising ratio is approximately l to 10.

The Department of Counselor Education offers three programs of study leading to the Master of Education Degree:

- Clinical Mental Health Counseling (p. 280),
- College Counseling and Student Development (p. 281), and
- School Counseling (p. 331).

Degrees earned will be distributed as: "Master of Education" without program of study specifications. Programs of study will only be printed on transcripts.

These programs of study require a minimum of 60 credits. Students who complete the program will be eligible to sit for the National Counselor Examination (NCE).

Student Financial Support

At NC State, our goal is to assure that no student who can benefit from an NC State education be denied that opportunity due to finances. We are committed to allocating our financial aid resources to help the broadest range of students.

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.

Degrees

- Clinical Mental Health Counseling (MEd) (p. 280)

Faculty

Clinical Mental Health Counseling (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**60**	
ECD 510	Orientation to Professional Counseling, Identity, and Ethics		
ECD 524	Career Counseling and Development		
ECD 525	Multicultural Counseling		
ECD 530	Theories and Tech of Counseling		
ECD 536	Introduction to Clinical Mental Health Counseling		
ECD 539	Group Counseling		
ECD 540	Gender Issues In Counseling		
ECD 541	Substance Abuse and Counseling		
ECD 542	Research in Counseling		
ECD 545	Counseling Couples and Families		
ECD 546	Crisis Interventions in Counseling		
ECD 561	Strategies for Clinical Assessment in Counseling		
ECD 562	Techniques in Counseling		
ECD 575	Multicultural Lifespan Development		
ECD 642	Practicum In Counseling		
ECD 653	Internship In Clinical Mental Health Counseling *		
Total Hours		**60**	

* ECD 653 covers over two semesters, Fall and Spring, 6 credits each, 12 credits total.

Faculty

College Counseling and Student Development

All master's degree programs (on-campus and online formats) are accredited by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024.

The doctoral program concentration in counseling and counselor education is accredited by the by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024.

Admission Requirements

Admissions Requirements for Master's Programs (on-campus and online programs):

- Completed online application, resume, personal statement/goals, and non-refundable application fee
- We are no longer requiring the GRE Scores/MAT Scores for our masters program
- 3 recommendations from people who know your academic record and potential for graduate study (letters should be uploaded online)
- Official transcripts of all post-secondary education
- Official** statement of English Proficiency (TOEFL) for international students

Applicants are expected to have an undergraduate GPA of 3.0 or higher.

Master's Degree Requirements

For master's degree concentrations, admission is limited in order to maintain faculty student interaction in didactic classes, for supervision in practica and for informal contact. Generally, class size averages

between 20 and 25 in didactic, 4-5 in practica, and the advising ratio is approximately l to 10.

The Master's of Education Degree (M.Ed.) is primarily a practitioner-oriented master's and is offered in the on-campus program or DE online program. The Department of Counselor Education offers three programs of study leading to the Master of Education Degree:

- Clinical Mental Health Counseling (p. 280),
- College Counseling and Student Development (p. 281), and
- School Counseling (p. 331).

Degrees earned will be distributed as: "Master of Education" without program of study specifications. Programs of study will only be printed on transcripts.

These programs of study require a minimum of 60 credits. Students who complete the program will be eligible to sit for the National Counselor Examination (NCE).

Student Financial Support

At NC State, our goal is to assure that no student who can benefit from an NC State education be denied that opportunity due to finances. We are committed to allocating our financial aid resources to help the broadest range of students. Go to the following Internet site for information about financial aid: http://www.fis.ncsu.edu/financial_aid/.

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.

Degrees

- College Counseling and Student Development (MEd) (p. 281)

Faculty

Stanley Baker

Marc A. Grimmett

Sylvia Christine Maria Nassar

Jose' A Picart

Siu-Man Ting

Adria Shipp Dunbar

Brean'a Parker

Cristina Braga

Nicole Marie Childs

Helen Lupton-Smith

Rolanda Levica Mitchell

Angela Carmella Smith

Teri Tilford

Elizabeth Vincent

Emeritus Faculty

Edwin Gerler

Amanda Allen

Clinton Bolton

Monica Osbourne

Richard Tyler-Walker

College Counseling and Student Development (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**60**	
ECD 510	Orientation to Professional Counseling, Identity, and Ethics		
ECD 524	Career Counseling and Development		
ECD 525	Multicultural Counseling		
ECD 530	Theories and Tech of Counseling		
ECD 535	Introduction to College Counseling and Student Development		
ECD 539	Group Counseling		
ECD 540	Gender Issues In Counseling		
ECD 541	Substance Abuse and Counseling		
ECD 542	Research in Counseling		
ECD 545	Counseling Couples and Families		
ECD 546	Crisis Interventions in Counseling		
ECD 561	Strategies for Clinical Assessment in Counseling		

ECD 562	Techniques in Counseling	
ECD 575	Multicultural Lifespan Development	
ECD 642	Practicum In Counseling	
ECD 652	Internship In College Counseling and Student Development *	
Total Hours		**60**

* ECD 652 Internship In College Counseling and Student Development covers over two semesters, Fall and Spring 6 credits each, 12 credit hours in total

Faculty

Stanley Baker

Marc A. Grimmett

Sylvia Christine Maria Nassar

Jose' A Picart

Siu-Man Ting

Adria Shipp Dunbar

Brean'a Parker

Cristina Braga

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Angela Carmella Smith

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Monica Osbourne

Richard Tyler-Walker

Curriculum and Instruction

The department of Teacher Education and Learning Sciences offers master's degrees in multiple areas of curriculum and instruction; Curriculum Development and Supervision, Educational Psychology, and New Literacies and Global Learning (with sub-concentrations in English education, general studies, middle grades, reading/ literacy education, and secondary social studies.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Curriculum and Instruction: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. The Graduate School requires a 3.0 in the undergraduate program. Students from diverse backgrounds are welcome to apply. Admission is competitive. The best qualified applicants will be accepted up to the limited number of spaces available for new students. TOEFL or IELTS scores for international applicants whose first language is not English. GRE scores not more than five years old are required for the Educational Psychology program area.

Master's Degree Requirements

Curriculum and Instruction: A minimum of 30 course credit hours. For the M.S. degree, a minimum of 36 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee.

Student Financial Support

Teaching Assistantships are available on a limited basis.

Degrees

- Curriculum and Instruction (MEd) (p. 284)
- Curriculum and Instruction (MEd): Educational Psychology Concentration (p. 285)
- Curriculum and Instruction, Curriculum and Developmental Supervision (MEd) (p. 287)
- Curriculum and Instruction, New Literacies and Global Learning (MEd) (p. 288)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): English Education Concentration (p. 289)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Middle Grades Education Concentration (p. 291)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Reading Education Concentration (p. 293)
- Curriculum and Instruction, New Literacies and Global Learning (MEd): Social Studies Education Concentration (p. 294)
- Curriculum and Instruction (MS) (p. 296)
- Curriculum and Instruction (MS): Educational Psychology Concentration (p. 297)
- Curriculum and Instruction, Curriculum and Developmental Supervision (MS) (p. 299)

- Curriculum and Instruction, New Literacies and Global Learning (MS) (p. 300)
- Curriculum and Instruction, New Literacies and Global Learning (MS): English Education Concentration (p. 302)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Reading Education Concentration (p. 304)
- Curriculum and Instruction, New Literacies and Global Learning (MS): Social Studies Education Concentration (p. 305)
- Counselor Education (Certificate) (p. 307)

Faculty

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Ellen S. Vasu

Curriculum and Instruction (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Select three hours of the following:		3	
ECI 501	Foundations of Curriculum		
ECI 508	Teachers as Leaders		
ECI 585	Education of Children with Exceptionalities		
ECI 806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice		
Select 18-24 credits of the following:		18-24	
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 716	Design and Evaluation Of Instructional Materials		
ECI 520	The Teaching Of Composition		
ECI 541	Reading In the Content Areas		
EDP 504	Advanced Educational Psychology		
EDP 582	Adolescent Development		
EDP 590	Special Problems in Educational Psychology		
PSY 508	Cognitive Processes		
Select 6-9 credit hours of the following:		6-9	
ECI 510	Research Applications In Curriculum and Instruction		
ECI 523	Teacher as Researcher		
EDP 560	Educational Testing and Measurement		
ECI 607	Advanced Seminar in Multicultural Education		
ST 507	Statistics For the Behavioral Sciences I		
ST 508	Statistics For the Behavioral Sciences II		
EAC 580	Designing Instructional Systems in Training and Development		
ECI 695	Master's Thesis Research		
ECI 699	Master's Thesis Preparation		
Total Hours			**30**

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Curriculum and Instruction (MEd): Educational Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18-24**	
Select 18-24 credits of the following courses:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 520	The Teaching Of Composition		
ECI 541	Reading In the Content Areas		
ECI 716	Design and Evaluation Of Instructional Materials		
EDP 504	Advanced Educational Psychology		
PSY 508	Cognitive Processes		
EDP 582	Adolescent Development		
EDP 590	Special Problems in Educational Psychology		
Curriculum and Learning Courses		**3**	
Select one of the following courses:			
ECI 501	Foundations of Curriculum		
ECI 508	Teachers as Leaders		
ECI 585	Education of Children with Exceptionalities		

ECI 806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice	
Research Courses		**6-9**
Select a minimum of two of the following courses:		
ECI 510	Research Applications In Curriculum and Instruction	
ECI 523	Teacher as Researcher	
EDP 560	Educational Testing and Measurement	
ECI 607	Advanced Seminar in Multicultural Education	
ST 507	Statistics For the Behavioral Sciences I	
ST 508	Statistics For the Behavioral Sciences II	
EAC 580	Designing Instructional Systems in Training and Development	
Total Hours		**30**

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Curriculum and Instruction, Curriculum and Developmental Supervision (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
Curriculum Theory			
ECI 501	Foundations of Curriculum		
ECI 511	Introduction to Learning Design and Technology [1]		
Diversity			
Select one of the following courses:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 585	Education of Children with Exceptionalities		
EDP 575	Multicultural Lifespan Development		
Teacher Leadership and Professional Development			
ECI 705	Instructional Coaching and Supervision Of Teachers		
ECI 606/806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice		
ECI 641/841	Practicum In Mentoring and Coaching		
or ECI 851	Internship In Mentoring		
Administration			
ECI 630	Independent Study in Curriculum and Instruction (Intro to Educational Law Independent Study)		
Elective Courses			**6**
"Elective Courses" will be determined in conjunction with the academic committee			
Research Courses			**3**
Select one of the following courses:			
ECI 510	Research Applications In Curriculum and Instruction		
ECI 523	Teacher as Researcher		
Total Hours			**30**

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Curriculum and Instruction, New Literacies and Global Learning (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		

Concentration Requirements

Code	Title	Hours	Counts towards
Elective Courses		**18**	
"Elective Courses" will be determined in conjunction with the academic committee			
Total Hours		**30**	

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Curriculum and Instruction, New Literacies and Global Learning (MEd): English Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECI 520	The Teaching Of Composition		

ECI 521	Teaching Literature For Young Adults	
Select one of the following:		
ECI 511	Introduction to Learning Design and Technology	
ECI 512	Emerging Technologies for Teaching and Learning	
ECI 513	Teaching and Learning with Digital Video	
ECI 514	Developing and Delivering Online Instruction	
ECI 515	Cultural Investigations and Technical Representations in Education	
ECI 516/716	Design and Evaluation Of Instructional Materials	
ECI 518	Digital Learning Program and Staff Development	
ECI 519	Special Problems in Learning Design and Technology	
Select one of the following:		
ECI 522	Trends and Issues in English Language Arts Education	
ECI 531	Advanced Writing in Education	
ECI 541	Reading In the Content Areas	
English Course		**3**
"English Course" will be determined in conjunction with the academic committee		
Education / English / Psychology Elective		**3**
"Education / English / Psychology Elective" will be determined in conjunction with the academic committee		
Total Hours		**30**

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Curriculum and Instruction, New Literacies and Global Learning (MEd): Middle Grades Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECI 550	Foundations Of Middle Years Education		
Select nine credit hours of the following:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 517	Theoretical Foundations of Advanced Learning Environments		
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 522	Trends and Issues in English Language Arts Education		
ECI 525	Contemporary Approaches In the Teaching Of Social Studies		

ECI 526	Theory and Research On Teaching and Learning Social Studies	
ECI 541	Reading In the Content Areas	
ECI 630/727	Independent Study in Curriculum and Instruction	
EDP 582	Adolescent Development	
EDP 504	Advanced Educational Psychology	
Social Studies / English Courses		**6**
"Social Studies / English Courses" are determined in conjunction with the academic committee		
Total Hours		**30**

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Curriculum and Instruction, New Literacies and Global Learning (MEd): Reading Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
ECI 540	Reading In the Elementary School		
ECI 541	Reading In the Content Areas		
ECI 509	Special Problems in Curriculum and Instruction		
ECI 543	Literacy Assessment and Intensified Instruction I		
ECI 544	Literacy Assessment and Intensified Instruction II		
ECI 645	Supervised Practicum in Literacy		
Total Hours		**30**	

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Curriculum and Instruction, New Literacies and Global Learning (MEd): Social Studies Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select 12 credit hours from the following courses:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 517	Theoretical Foundations of Advanced Learning Environments		
ECI 525	Contemporary Approaches In the Teaching Of Social Studies		
ECI 526	Theory and Research On Teaching and Learning Social Studies		
ECI 550	Foundations Of Middle Years Education		
ECI 630/727	Independent Study in Curriculum and Instruction		
EDP 504	Advanced Educational Psychology		

EDP 582	Adolescent Development	
Social Studies Courses		**6**
"Social Studies Courses" are determined in conjunction with the academic committee [1]		
Total Hours		**30**

[1] Students are required to take courses with Social Studies content that include: history, political science, economics, anthropology, geography, social studies pedagogy.

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Curriculum and Instruction (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**30**	
Select 30 Curriculum and Instruction credit hours of the following:			
ECI 501	Foundations of Curriculum		
ECI 508	Teachers as Leaders		
ECI 585	Education of Children with Exceptionalities		
ECI 806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice		
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 716	Design and Evaluation Of Instructional Materials		
ECI 520	The Teaching Of Composition		
ECI 541	Reading In the Content Areas		
EDP 504	Advanced Educational Psychology		
EDP 582	Adolescent Development		
EDP 590	Special Problems in Educational Psychology		
PSY 508	Cognitive Processes		
ECI 510	Research Applications In Curriculum and Instruction		
ECI 523	Teacher as Researcher		
EDP 560	Educational Testing and Measurement		
ECI 607	Advanced Seminar in Multicultural Education		
ST 507	Statistics For the Behavioral Sciences I		
ST 508	Statistics For the Behavioral Sciences II		
EAC 580	Designing Instructional Systems in Training and Development		
Thesis Courses		**6**	
ECI 695	Master's Thesis Research		
ECI 699	Master's Thesis Preparation		
ECI 695	Master's Thesis Research		
Total Hours		**36**	

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Curriculum and Instruction (MS): Educational Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18-24**	
Select a minimum of six of the following courses:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 511	Introduction to Learning Design and Technology		
ECI 716	Design and Evaluation Of Instructional Materials		
ECI 520	The Teaching Of Composition		
ECI 541	Reading In the Content Areas		
EDP 504	Advanced Educational Psychology		
EDP 582	Adolescent Development		
EDP 590	Special Problems in Educational Psychology		
PSY 508	Cognitive Processes		
Curriculum and Learning Course		**3**	
Select one of the following courses:			
ECI 501	Foundations of Curriculum		
ECI 508	Teachers as Leaders		
ECI 585	Education of Children with Exceptionalities		

ECI 806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice	
Research Courses		**6-9**
EAC 580	Designing Instructional Systems in Training and Development	
ECI 510	Research Applications In Curriculum and Instruction	
ECI 523	Teacher as Researcher	
ECI 607	Advanced Seminar in Multicultural Education	
EDP 560	Educational Testing and Measurement	
ST 507	Statistics For the Behavioral Sciences I	
ST 508	Statistics For the Behavioral Sciences II	
Thesis Courses		**6**
ECI 695	Master's Thesis Research	
ECI 699	Master's Thesis Preparation	
Total Hours		**30**

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Norman A. Sprinthall

Lois M. Thies-Sprinthall

Ellen S. Vasu

Curriculum and Instruction: Curriculum and Developmental Supervision (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
Curriculum Theory			
ECI 501	Foundations of Curriculum		
ECI 511	Introduction to Learning Design and Technology [1]		
Diversity			
Select one of the following courses:			
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 585	Education of Children with Exceptionalities		
EDP 575	Multicultural Lifespan Development		
Teacher Leadership and Professional Development			
ECI 705	Instructional Coaching and Supervision Of Teachers		
ECI 606/806	Seminar on Teacher as Learner: Developmental Theory, Research and Practice		
ECI 641/841	Practicum In Mentoring and Coaching		
or ECI 851	Internship In Mentoring		
Administration			
ECI 630	Independent Study in Curriculum and Instruction (Intro to Educational Law Independent Study)		
Elective Courses			**6**
"Elective Courses" will be determined in conjunction with the academic committee			
Research Courses			**6**
Select two of the following courses:			
ED 700	Introduction to Research Design in Education		
ED 710	Applied Quantitative Methods in Education I		
ED 730	Introduction to Qualitative Research in Education		
ECI 523	Teacher as Researcher		
Thesis Course			**6**
ECI 695	Master's Thesis Research		
Total Hours			**39**

Faculty

Full Professors

Cathy L. Crossland

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Curriculum and Instruction, New Literacies and Global Learning (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		
Specialty Courses		**9**	
ECI 550	Foundations Of Middle Years Education		

ECI 510	Research Applications In Curriculum and Instruction	
ECI 695	Master's Thesis Research	
Elective Courses		**15**
Select a minimum of 15 hours listed under "Elective Courses" below		
Total Hours		**36**

Elective Courses

English Language Arts (ELA) Education

Code	Title	Hours	Counts towards
Select three courses from the following:		**9**	
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 541	Reading In the Content Areas		
ECI 522	Trends and Issues in English Language Arts Education		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ELA Content Courses		**6**	
Select a minimum of two courses from an English discipline (literature, language, writing, film) approved in conjunction with the academic committee			
Total Hours		**15**	

Social Studies Education

Code	Title	Hours	Counts towards
Select three courses from the following:		**9**	
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 525	Contemporary Approaches In the Teaching Of Social Studies		
ECI 526	Theory and Research On Teaching and Learning Social Studies		
ECI 630	Independent Study in Curriculum and Instruction		
or ECI 727	Special Problems in Social Studies Education		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
Social Studies Content Courses		**6**	
Select a minimum of two courses from a Social Studies discipline (history, political science, economics, anthropology, or geography) approved in conjunction with the academic committee			
Total Hours		**15**	

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Curriculum and Instruction, New Literacies and Global Learning (MS): English Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		
Specialty Courses		**9**	
ECI 550	Foundations Of Middle Years Education		

ECI 510	Research Applications In Curriculum and Instruction	
ECI 695	Master's Thesis Research	
Elective Courses		**15**
Select a minimum of 15 hours listed under "Elective Courses" below		
Total Hours		**36**

Elective Courses

Code	Title	Hours	Counts towards
Select three courses from the following:		**9**	
ECI 500	Theory and Practice In Teaching Diverse Populations		
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 541	Reading In the Content Areas		
ECI 522	Trends and Issues in English Language Arts Education		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ELA Content Courses		**6**	
Select a minimum of two courses from an English discipline (literature, language, writing, film) approved in conjunction with the academic committee			
Total Hours		**15**	

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Ellen S. Vasu

Curriculum and Instruction, New Literacies and Global Learning (MS): Reading Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		
Specialty Courses		**9**	
ECI 550	Foundations Of Middle Years Education		
ECI 510	Research Applications In Curriculum and Instruction		
ECI 695	Master's Thesis Research		
Elective Courses		**15**	
Select a minimum of 15 hours listed under "Elective Courses" below			
Total Hours		**36**	

Elective Courses

Code	Title	Hours	Counts towards
Elective Courses		**15**	
"Elective Courses" will be determined in conjunction with the academic committee			

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Curriculum and Instruction, New Literacies and Global Learning (MS): Social Studies Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 546	New Literacies & Media		
ECI 524	Theory and Research in Global Learning		
ECI 523	Teacher as Researcher		
ECI 508	Teachers as Leaders		
Specialty Courses		**9**	
ECI 550	Foundations Of Middle Years Education		
ECI 510	Research Applications In Curriculum and Instruction		
ECI 695	Master's Thesis Research		
Elective Courses		**15**	
Select a minimum of 15 hours listed under "Elective Courses" below			
Total Hours		**36**	

Elective Courses

Code	Title	Hours	Counts towards
Select three courses from the following:		**9**	
ECI 500	Theory and Practice In Teaching Diverse Populations		

ECI 525	Contemporary Approaches In the Teaching Of Social Studies	
ECI 526	Theory and Research On Teaching and Learning Social Studies	
ECI 630	Independent Study in Curriculum and Instruction	
or ECI 727	Special Problems in Social Studies Education	
ECI 511	Introduction to Learning Design and Technology	
ECI 512	Emerging Technologies for Teaching and Learning	
ECI 513	Teaching and Learning with Digital Video	
ECI 514	Developing and Delivering Online Instruction	
ECI 515	Cultural Investigations and Technical Representations in Education	
Social Studies Content Courses		**6**
Select a minimum of two courses from a Social Studies discipline (history, political science, economics, anthropology, or geography) approved in conjunction with the academic committee		
Total Hours		**15**

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Counselor Education (Certificate)

Our innovative online program prepares school teachers, administrators, staff, advisors, tutors in schools and universities, human service workers, and individuals interested in counseling work to advocate and support students, their families, clients and local communities. Our certificate program allows students to learn in a flexible environment, with flexible online classwork, without the hassle of traffic and on-campus parking. Students will meet online each week for a 90-minute interactive discussion with the professor, instructors and classmates, in order to stay connected and challenged. The certificate program alone does not prepare students to work as professional counselors. In order to work in professional counseling, additional classes, training and licensure will be required through a master's degree program.

Admission Requirements

Applicants should have a 3.0 GPA but may be admitted provisionally based on related graduate classes completed in the field of education, human services or training and development, and, ultimately, by earning at least a "B" (3.0) average in the first GCCE class.

- Completed online Graduate School application and admission fee
- Resume outlining education and work experience

Applications are considered to begin the GCCE program in ***Summer II (Application Deadline of May 16 by 5 pm) or Fall (Application deadline of August 15 by 5 pm)***. These two main points serve as a great way to begin the GCCE program with registration for either Orientation to Professional Counseling, Identity, and Ethics (Summer II) or Multicultural Lifespan Development (Fall). If there are available seats throughout the rest of the academic year, it might be possible for a few students to begin the GCCE program during Summer I or Spring semesters.

Email us at ncsu_gcce@ncsu.edu with any questions.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**13**	
ECD 510	Orientation to Professional Counseling, Identity, and Ethics		
ECD 575	Multicultural Lifespan Development		
ECD 530	Theories and Tech of Counseling		
ECD 525	Multicultural Counseling		
Total Hours		**13**	

Educational Administration and Supervision

NC State's Ed.D. in Educational Administration & Supervision program is tied for #14 in U.S. News & World Report's rankings of 393 graduate programs in the U.S. and ranked #1 in North Carolina! The program is designed to prepare systems-level leaders to improve the quality of K-12 schools by preparing the next generation of superintendents dedicated to educational excellence and equity. Graduates are empowered with leadership strategies that improve student performance in environments that are dynamic, interactive, and culturally diverse.

Program Description

The Ed.D. in Educational Administration & Supervision leads to district/superintendent licensure and requires core courses in educational leadership, research methods (9 hours), an internship (6 hours), and a dissertation (12 hours). Students must be officially admitted to the Ed.D. program to enroll in doctoral classes. Please be aware that a Ph.D. in Educational Evaluation and Policy Analysis is also offered, but only the Ed.D. leads to superintendent licensure.

Course of Study

The program requires a minimum of 54 credit hours beyond the master's degree. Students complete 27 hours of core and elective courses, 9 credit hours of research methods, a two semester internship (6 hours), and 12 hours of dissertation research.

Admission Requirements

Applicants must hold a North Carolina Principal's license or be eligible to receive one; transcripts; three letters of reference (at least one must be from your current supervisor); resume (including teaching assignments, leadership experiences, and trainings); personal statement of interest and fit with career goals; and official score report from either the Miller Analogies Test (MAT) or the Graduate Record Exam (GRE). Test should have been taken within the last five years.

Degrees

- Educational Administration and Supervision (EdD) (p. 308)
- Educational Administration and Supervision (Minor) (p. 309)

Faculty

Full Professors

Bonnie C Fusarelli

Lance D. Fusarelli

Associate Professors

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Anna Margaret Jacob

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Practice/Research/Teaching Professors

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Henry Johnson

Francine Piscitelli Riddick

Michael Ward

Emeritus Faculty

Paul F. Bitting

Adjunct Faculty

John D. Enamait

Educational Administration and Supervision (EdD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**27**	
Select a minimum of nine of the following courses:			
ELP 720	Cases In Educational Administration		
ELP 724	Contemporary Educational Thought		
ELP 728	School Law For the Administrator		
ELP 729	Educational Finance		
ELP 735	Policy Research in Education		
ELP 751	Politics of P-12 Education		
ELP 753	Data Decision Making for School Administrators		
ELP 756	Organizational Leadership & Mangement for School Leaders		
ELP 780	Evaluation Theory and Practice In Education		
ELP 789	Personnel Recruitment, Selection, Development and Appraisal in Education		
ELP 795	Special Topics [1]		
ELP 820	Special Problems In Education [2]		
Research Methods and Data Analysis Courses		**9**	
Select a minimum of three courses of the following:			
ED 710	Applied Quantitative Methods in Education I		
ED 711	Applied Quantitative Methods in Education II		
ED 730	Introduction to Qualitative Research in Education		
ED 731	Advanced Qualitative Research and Data Analysis in Education		
Internship Courses		**6**	

ELP 851	Internship In Educational Leadership and Program Evaluation [3]	
Dissertation Preparation / Writing Courses		**12**
ELP 891	Problems Of Research Design In Education	
ELP 895	Doctoral Dissertation Research	
Total Hours		**54**

1 ELP 795 Special Topics may be repeated for credit.

2 ELP 820 Special Problems In Education may be repeated once for credit.

3 ELP 851 Internship In Educational Leadership and Program Evaluation must be repeated consecutively.

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Educational Administration and Supervision (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Educational Leadership, Policy and Human Development

The Adult, Workforce, and Continuing Professional Education specialization with the Ph.D. in Educational Leadership, Policy, and Human Development is unique in its emphasis on serving the spectrum of both formal and informal adult learning organizations, and its inclusion of administrative, instructional and technology-related leadership within a practitioner preparation program. Based on a land-grant, Research Extensive University, the department reflects the tripartite commitment to quality instruction, research scholarship and service outreach.

The Ph.D. in Educational Leadership, Policy, and Human Development with a specialization in Adult, Workforce, and Continuing Professional Education, is one-of-a-kind as its primary commitment is to part-time students who are full-time working professionals. Full-time students are eligible for consideration to receive full funding through scholarships, fellowships and research and teaching assistantships, which allow our students to work with top faculty on cutting-edge projects. To meet the needs of full- and part-time students, most courses are offered once a week during late afternoon or evening hours. Some courses are regularly available during summer sessions and weekends and through distance education technologies.

Admission Requirements

Applications for admission are submitted through the Graduate School. We accept students from a wide range of educational backgrounds. To qualify for admission, applicants must have a master’s degree from an accredited institution of higher education in any field. International applicants must also have a TOEFL score of 100 or higher. Admission decisions are based on several criteria, including undergraduate GPA, work history and interest in the field.

Student Financial Support

To be eligible for financial aid, students must be enrolled in Master's or Doctoral degree programs offered by the University. Unfortunately there is no financial aid available for Graduate Certificate students. Occasionally graduate assistantships are available for full time students in our degree programs. Please check with your advisor about assistantship opportunities.

Degrees

- Educational Leadership, Policy, and Human Development (PhD) (p. 311)
- Educational Leadership, Policy, and Human Development (PhD): Counseling and Counselor Education Concentration (p. 314)
- Education Research & Policy Analysis (Minor) (p. 315)
- Teaching, Training, and Educational Technology (Certificate) (p. 316)

Faculty

Duane Akroyd

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Mary Ann Danowitz

Mattie Jayne Fleener

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Lance D. Fusarelli

Joy Gaston Gayles

Marc Anderson Grimmett

Audrey J. Jaeger

Glenn Marshall Kleiman

Sylvia Christine Maria Nassar

Jose' A. Picart

Stephen Robert Porter

Alyssa Nicole Rockenbach

Siu-Man Ting

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Lam Pham

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Rufus Glasper

David Gomez

Anthony Hancock

Garrett D. Hinshaw

David N. Johnson

Daniel J. Phelan

Casey Sacks

Janice Nichols Spriggs

Holly Anna Sullenger

Katherine C. Titus-Becker

Thomas A. Walker

Gregory D. Williams

Yolanda Sheree Wilson

Joshua S. Wyner

Educational Leadership, Policy, and Human Development (PhD)

Degree Requirements

Degrees earned will be distributed as: "Doctor of Philosophy in Education Leadership, Policy and Human Development" without specialization specifications.

Code	Title	Hours	Counts towards
Scholar Leader Courses		**6**	
ED 795	Special Topics in Education Research (Scholar Leader: Diversity and Equity in Schools and Community)		
ED 795	Special Topics in Education Research (Scholar Leader: Systemic Change in Education and Society)		
Required College Research Methods *		**15**	
ED 710	Applied Quantitative Methods in Education I		
ED 730	Introduction to Qualitative Research in Education		
ED 711	Applied Quantitative Methods in Education II		
or ED 731	Advanced Qualitative Research and Data Analysis in Education		
or ED 750	Mixed Methods Research in Education		
Select two additional three credit hour advanced research courses in conjunction with the academic committee			

* ED 700 Introduction to Research Design in Education, or its equivalent is a pre-requisite course for any research course. A graduate student may take it as part of their Program Area of Study, with approval from their advisor.

In addition, students must select a specialization of the following:

Adult, Workforce, and Continuing Professional Education (AWCPE)

Code	Title	Hours	Counts towards
Scholar Leader Core Courses		**6**	
EAC 711	Reflective Practice and Research Inquiry		
EAC 803	Research Seminar in Adult and Higher Education		
AWCPE Area of Study Courses		**12**	
EAC 730	Foundations of Adult, Higher, and Human Res Education		
or EAC 710	Adult Education: History, Philosophy, Contemporary Nature		
EAC 759	Adult Learning Theory		
EAC 703	The Programming Process In Adult and Community College Education		
ELP 780	Evaluation Theory and Practice In Education		
Elective Courses		**12**	
"Elective Courses" will be determined in conjunction with the academic committee			
Dissertation Courses [1]		**9**	
EAC 895	Doctoral Dissertation Research		
or EAC 899	Doctoral Dissertation Preparation		
Total Hours		**72**	

[1] **For doctoral students either part-time or full-time who are working on their dissertation:** Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for EAC 895 Doctoral Dissertation Research or EAC 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Educational Evaluation and Policy Analysis (EEPA)

Code	Title	Hours	Counts towards
Scholar Leader Core Courses		**6**	
ELP 892	Research Projects In Educational Leadership and Program Evaluation		
Select an additional ELP approved course in conjunction with the academic committee			
EEPA Area of Study Courses		**18-30**	
"EEPA Area of Study Courses" are determined in conjunction with the academic committee; however, a sample selection of courses includ:			
ELP 728	School Law For the Administrator		
ELP 729	Educational Finance		
ELP 735	Policy Research in Education		
ELP 751	Politics of P-12 Education		
ELP 780	Evaluation Theory and Practice In Education		
ELP 795	Special Topics		
Dissertation Courses [1]		**9**	
ELP 891	Problems Of Research Design In Education		
ELP 895	Doctoral Dissertation Research		
ELP 899	Doctoral Dissertation Preparation		
Total Hours		**72**	

[1] **For doctoral students either part-time or full-time who are working on their dissertation:** Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for ELP 891 Problems Of Research Design In Education, ELP 895 Doctoral Dissertation Research, or ELP 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Higher Education (HE)

Code	Title	Hours	Counts towards
Scholar Leaders Core Courses			
EAC 795	Topical Problems in Adult and Community College Education		
EAC 803	Research Seminar in Adult and Higher Education		
HE Area of Study Courses		**6**	
EAC 749	Finance in Higher Education		
EAC 787	Organizational Theories and Concepts in Higher Education		
Elective Courses		**15**	
"Elective Courses" will be determined in conjunction with the academic committee			
Advanced Research Course		**4**	
"Advanced Research Course" will be determined in conjunction with the academic committee			
Dissertation Research Course [1]		**9**	
EAC 895	Doctoral Dissertation Research		
Total Hours		**72**	

[1] **For doctoral students either part-time or full-time who are working on their dissertation:** Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for EAC 895 Doctoral Dissertation Research register for at least 3 semester hours per semester, when appropriate.

Faculty

Duane Akroyd

Stanley B. Baker

Mary Ann Danowitz

Mattie Jayne Fleener

Bonnie C. Fusarelli

Lance D. Fusarelli

Joy Gaston Gayles

Marc Anderson Grimmett

Audrey J. Jaeger

Glenn Marshall Kleiman

Sylvia Christine Maria Nassar

Jose' A. Picart

Stephen Robert Porter

Alyssa Nicole Rockenbach

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Timothy Arthur Drake

Adria Shipp Dunbar

Michael Little

Lam Pham

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Patricia Andrews Ashley

Krispin Wagoner Barr

Michelle E. Bartlett

Cristina Braga

Brenda D. Champion

Diane Dolores Chapman

Nicole Marie Childs

Callie Womble Edwards

Peter A. Hessling

Gregory Eugene Hicks

Robert Grant Templin Jr.

Helen S. Lupton-Smith

Barry A. Olson

Francine Piscitelli Riddick

Angela Carmella Smith

Terri Tilford

Elizabeth A. Vincent

Cathy Sue Williams

Susan Smith Braithwaite

William S. Carver

David Martin Coniglo

Jeffrey A. Cox

Kandi W. Deitemeyer

Rufus Glasper

David Gomez

Anthony Hancock

Garrett D. Hinshaw

David N. Johnson

Daniel J. Phelan

Casey Sacks

Janice Nichols Spriggs

Holly Anna Sullenger

Katherine C. Titus-Becker

Thomas A. Walker

Gregory D. Williams

Yolanda Sheree Wilson

Joshua S. Wyner

Educational Leadership, Policy, and Human Development (PhD): Counseling and Counselor Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Scholar Leader Courses		**6**	
ED 795	Special Topics in Education Research (Scholar Leader: Diversity and Equity in Schools and Community)		
ED 795	Special Topics in Education Research (Scholar Leader: Systemic Change in Education and Society)		
Required College Research Methods *		**15**	
ED 710	Applied Quantitative Methods in Education I		
ED 730	Introduction to Qualitative Research in Education		
ED 711	Applied Quantitative Methods in Education II		
or ED 731	Advanced Qualitative Research and Data Analysis in Education		
or ED 750	Mixed Methods Research in Education		
Select two additional three credit hour advanced research courses in conjunction with the academic committee			

* ED 700 Introduction to Research Design in Education, or its equivalent is a pre-requisite course for any research course. A graduate student may take it as part of their Program Area of Study, with approval from their advisor.

Concentration Requirements

Code	Title	Hours	Counts towards
Scholar Core Required Courses or Experiences		**6**	
ECD 732	Advanced Multicultural Counseling		
ECD 860	Professional Issues In Counseling		
Program Area of Study [1]		**21**	
ECD 731	Career Development Theory and Research		
ECD 735	Counseling Supervision: Theory and Research		
ECD 843	Advanced Counseling Practicum		
ECD 847	Internship in Supervision		
ECD 850	Doctoral Internship		
ECD 886	Internship in Teaching in Counselor Education		
Thesis Equivalence Course		**2**	
ECD 892	Doctoral Research Projects		
Dissertation Courses [3]		**9**	
ECD 895	Doctoral Dissertation Research		
or ECD 899	Doctoral Dissertation Preparation		
Total Hours		**72**	

1 Prerequisites: (number of credits: zero to variable) 600 hour internship and masters level course work equivalent to those of a CACREP accredited program. Because of the impact of COVID-19 pandemic, the accreditation review has been delayed. We expect to receive a one-year extension of accreditation from CACREP to complete the review process.

2 A thesis equivalent is a program requirement for those not having completed a thesis during their master's program.

3 For doctoral students either part-time or full-time who are working on their dissertation. Writing the dissertation requires a major commitment of time and effort on both the part of the doctoral student and the faculty advisor. There should be consultation between the student and the dissertation chair about what is expected to be accomplished, and how much time is to be invested before the student registers. The College of Education strongly recommends that students who are registering for ECD 895 Doctoral Dissertation Research or ECD 899 Doctoral Dissertation Preparation register for at least 3 semester hours per semester, when appropriate.

Education Research & Policy Analysis (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Duane Akroyd

Stanley B. Baker

Mary Ann Danowitz

Mattie Jayne Fleener

Bonnie C. Fusarelli

Lance D. Fusarelli

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Audrey J. Jaeger

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Thomas A. Walker

Gregory D. Williams

Yolanda Sheree Wilson

Joshua S. Wyner

Teaching, Training, and Educational Technology (Certificate)

Delivered 100% online, the Certificate consists of five 3-credit courses focused on teaching, training, and the use of technology in a variety of educational environments. Students can tailor the program to meet their needs and gain the knowledge and skills necessary to design and deliver course-related content through face-to-face, technology-enhanced, and e-learning environments. The program is designed for mid-career individuals who may be without academic preparation for their current positions, or for those choosing to increase their knowledge and skills in the field for future job opportunities.

Students may choose one of the following specialty areas:

- Training and Development,
- Instructional Design,
- E-Learning,
- Community College Teaching,
- and Community College Leadership.

In order to be awarded the Certificate, all required courses must be taken and one elective is allowed. Transfer credit from other institutions is not allowed.

Plan Requirements

Students can choose courses from the following specializations:

- Talent Development (p. 316)
- Instructional Design (p. 316)
- E-Learning / Educational Technology (p. 317)
- Community College Teaching (p. 317)
- Community College Leadership (p. 317)

Certificates earned will be distributed as: "Graduate Certificate in Teaching, Training, and Educational Technology" without focus area specifications.

Talent Development

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 559	The Adult Learner	3	
EAC 582	Organization and Operation Of Training and Development Programs	3	
EAC 586	Methods and Techniques Of Training and Development	3	
Select one of the following electives:		3	
EAC 556	Organization Change in HRD: Theory & Practice		
EAC 580	Designing Instructional Systems in Training and Development		
EAC 584	Evaluating Training Transfer and Effectiveness		
Total Hours		**15**	

Instructional Design

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 580	Designing Instructional Systems in Training and Development	3	
EAC 581	Advanced Instructional Design in Training and Development	3	
EAC 583	Needs Assessment and Task Analysis in Training and Development	3	
Select one of the following electives:		3	

EAC 559	The Adult Learner	
EAC 584	Evaluating Training Transfer and Effectiveness	
EAC 585	Integrating Technology into Training Program	
Total Hours		**15**

E-Learning / Educational Technology

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 539	Teaching in the Online Environment	3	
EAC 580	Designing Instructional Systems in Training and Development	3	
EAC 585	Integrating Technology into Training Program	3	
Select one of the following electives:		3	
EAC 581	Advanced Instructional Design in Training and Development		
EAC 583	Needs Assessment and Task Analysis in Training and Development		
EAC 560/584	Assessment & Evaluation in Adult & Higher Education		
Total Hours		**15**	

Community College Teaching

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 559	The Adult Learner	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 539	Teaching in the Online Environment	3	
or EAC 700	Community College and Two-Year Postsecondary Education		
Total Hours		**15**	

Community College Leadership

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 595	Special Topics (Leadership)	3	
EAC 700	Community College and Two-Year Postsecondary Education	3	
EAC 704	Leadership In Higher and Community College Education	3	
Select one of the following:		3	
EAC 559	The Adult Learner		
EAC 703	The Programming Process In Adult and Community College Education		
EAC 795	Topical Problems in Adult and Community College Education (Contemporary Issues in Adult and Community College Education)		
EAC 778	Law and Higher Education		
Total Hours		**15**	

Elementary Education

The Elementary Education program in the TELS department offers a Master of Education (M.Ed.) degree in Elementary Education with a

concentration in either mathematics or science education. The Master's program prepares teacher leaders who possess strong specialized content knowledge in mathematics or science and a deep understanding of how elementary students learn. The program, designed for those who already hold a current teaching license, is especially tailored to provide candidates with leadership and application skills to transfer their knowledge to their work with elementary school teachers and students.

The program is considered Distance Education (DE) and offered off campus at school sites in the region to take advantage of reduced DE tuition rates.

The coursework for the mathematics and science concentrations are approved by the North Carolina State Board of Education. Therefore, graduates of the M.Ed. program are eligible to receive the elementary mathematics or elementary science specialist add-on to their North Carolina K-6 teaching license from the Department of Public Instruction. The College of Education is accredited by the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Elementary Education Master's program: Application requirements include a 500-800 word statement describing professional goals, transcripts and reference letters, and a teaching license. The Graduate School requires a 3.0 GPA in an undergraduate program. The best qualified applicants will be accepted up to the limited number of spaces available for new students.

For the M.S. degree, a minimum of 33 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee. It is the responsibility of MS students to secure an advisor in advance to supervise their thesis research.

Degrees

- Elementary Education (MEd) (p. 318)
- Elementary Education (MS) (p. 319)

Faculty

Full Professors

Paola Sztajn

Associate Professors

Sarah J. Carrier

Jessica Heather Hunt

James Minogue

Temple A. Walkowiak

Assistant Professors

Jill Freiberg Grifenhagen

Jonee Wilson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Elementary Education (MEd)

Degree Requirements

Math Leader

Code	Title	Hours	Counts towards
Required Courses			
ELM 555	Number Systems and Operations: K-5 Mathematical Tasks	3	
ELM 556	Rational Numbers and Operations: K-5 Learning Trajectories	3	
ELM 557	Data Analysis and Measurement: K-5 Classroom Interactions	3	
ELM 558	Algebraic Reasoning: K-5 Discourse and Questioning	3	
ELM 559	Geometry and Spatial Visualization: K-5 Assessment	3	
ELM 560	Mathematical Modeling: K-5 Leadership	3	
ELM 520	Methods of Teaching Elementary School Science	3	
ELM 530	Social Studies In the Elementary School	3	
ECI 541	Reading In the Content Areas	3	
ELM 654	Internship In Elementary Education (Inquiry Project)	1-6	
Total Hours		**28-33**	

Science Leader

Code	Title	Hours	Counts towards
ELM 524	Issues in Elementary School Science Education	3	

ELM 539	Special Problems in Elementary School Science	3
ELM 520	Methods of Teaching Elementary School Science	3
ELM 530	Social Studies In the Elementary School	3
ECI 541	Reading In the Content Areas	3
ELM 654	Internship In Elementary Education	1-6
Life Science Content		3
Earth Science Content		3
Physical Science Content		3
Total Hours		**25-30**

Faculty

Full Professors

Paola Sztajn

Associate Professors

Sarah J. Carrier

Jessica Heather Hunt

James Minogue

Temple A. Walkowiak

Assistant Professors

Jill Freiberg Grifenhagen

Jonee Wilson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Elementary Education (MS)

Degree Requirements

The College of Education is no longer admitting students in the Master of Science in Elementary Education degree program.

Degrees earned will be distributed as: "Master of Science in Elementary Education" without specialization specifications.

Mathematics Specialization

Code	Title	Hours	Counts towards
Required Courses		**30**	
ELM 555	Number Systems and Operations: K-5 Mathematical Tasks		
ELM 556	Rational Numbers and Operations: K-5 Learning Trajectories		
ELM 557	Data Analysis and Measurement: K-5 Classroom Interactions		
ELM 558	Algebraic Reasoning: K-5 Discourse and Questioning		
ELM 559	Geometry and Spatial Visualization: K-5 Assessment		
ELM 560	Mathematical Modeling: K-5 Leadership		
ELM 654	Internship In Elementary Education		
ELM 520	Methods of Teaching Elementary School Science		
ECI 585	Education of Children with Exceptionalities		
ECI 541	Reading In the Content Areas		
Research Courses		**6**	
Select a research elective approved in conjunction with the academic committee			
ECI 695	Master's Thesis Research		
Total Hours		**36**	

Science Specialization

Code	Title	Hours	Counts towards
Required Courses		**30**	
ELM 520	Methods of Teaching Elementary School Science		

ELM 524	Issues in Elementary School Science Education	
ELM 539	Special Problems in Elementary School Science	
MEA 517	Fundamentals of Climate Change Science	
PY 599	Special Topics in Physics	
BSC 514	Studying Animal Behavior	
ELM 654	Internship In Elementary Education	
ELM 555	Number Systems and Operations: K-5 Mathematical Tasks	
ECI 585	Education of Children with Exceptionalities	
ECI 541	Reading In the Content Areas	
Research Courses		**6**
Select a research elective approved in conjunction with the academic committee		
ECI 695	Master's Thesis Research	
Total Hours		**36**

Faculty

Full Professors

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James Minogue

Temple A. Walkowiak

Assistant Professors

Jill Freiberg Grifenhagen

Jonee Wilson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Higher Education Administration

NC State's Higher Education program provides exceptional opportunities for students interested in higher education administration to explore a core body of knowledge, gain real-world professional experience and pursue advanced study. Program content is informed by relevant theory, scholarly research and best practice in the fields of higher education and student affairs. In addition, the program links theoretical foundations of higher education leadership and administration to practical application of skills.

Students in the program, you will develop the professional expertise required for entry or advancement in colleges and universities, governmental agencies or public service organizations.

By participating in this master's program, students will benefit from several distinct program characteristics:

- Diverse students and faculty representing a variety of backgrounds, experiences and research interests
- A commitment to educational equity
- Access to multiple institutional types in the Triangle area that provide diverse contexts for learning and professional development

Admissions Requirements

- Personal statement of interest and desired career goals
- Professional resume or CV
- Transcripts from all institutions attended (except NC State)
- Three professional/academic recommendations
- TOEFL or IELTS scores for international students

Master of Education

At 39 credit hours, typically the Master of Education (M.Ed.) in Higher Education Administration degree takes 2–3 years to complete, depending on enrollment status.

Degrees

- Higher Education Administration (MEd) (p. 321)

Faculty

Full Professors

Joy Gaston Gayles

Alyssa Nicole Rockenbach

Paul David Umbach

Practice/Research/Teaching Professors

Krispin Wagoner Barr

Callie Womble Edwards

Barry A. Olson

David J. English

Higher Education Administration (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
EAC 540	Foundations of Higher Education and Student Affairs		
EAC 542	College Environments		
EAC 543	Student Development Theory		
EAC 545	Higher Education Masters Professional Seminar		
EAC 595	Special Topics (College Outcomes)		
EAC 595	Special Topics (Diversity in Higher Education)		
Research Component		**3**	
EAC 595	Special Topics (Research and Assessment in Higher Education)		
Experiential (Internship / Practicum) Component		**3**	
EAC 651	Internship In Adult and Community College Education		
Elective Courses		**15**	
Select 15 credit hours of Higher Education Threads approved in conjunction with the academic committee			
Total Hours		**36**	

Faculty

Full Professors

Joy Gaston Gayles

Alyssa Nicole Rockenbach

Paul David Umbach

Practice/Research/Teaching Professors

Krispin Wagoner Barr

Callie Womble Edwards

Barry A. Olson

David J. English

Learning and Teaching in STEM

The Department of Science, Technology, Engineering and Mathematics (STEM) Education offers a Doctor of Philosophy (PhD) in Learning and Teaching in STEM with three areas of concentration: Science Education, Engineering and Technology Education, and Mathematics and Statistics Education.

We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty, in general professional education, and in academic discipline areas including: biological sciences, chemistry, computer science, earth science, engineering, graphic arts, interdisciplinary science, mathematics, physics, or statistics.

Doctoral students are knowledge-seekers and who are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

- scholarly inquiry and discourse in their discipline,
- preparation of K-12 teachers,
- instruction and development issues in K-16, and
- leadership positions.

Admission Requirements

Applicants must submit a completed application specific to the program concentration. All programs require GRE scores, 3 letters of recommendation, official transcripts, and a 1-2 page statement describing interests, background, and professional goals.

Please see the Learning and Teaching in STEM, PhD website for additional details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program area of study.

Doctoral Degree Requirements

The Ph.D. program in Learning and Teaching in STEM requires a previous master’s degree, a minimum of 54 semester hours of course work, and 9 semester hours of dissertation research beyond the Master's Degree requirements.

*Note: Some programs may allow exceptional applicants to earn a Master’s degree en route to a Ph.D., with up to 36 hours counting toward the Ph.D. with continuous enrollment.

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for

students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

- Learning & Teaching in STEM (PhD) (p. 322)

Faculty

Full Professors

Margaret R. Blanchard

Sarah J. Carrier

Aaron Catron Clark

Jo-Ann D. Cohen

Karen Flanagan Hollebrands

Carla Johnson

Melissa Gail Jones

Hollylynne Stohl Lee

Soonhye Park

Eric N. Wiebe

Associate Professors

Cesar Delgado

Cameron Denson

Jessica Heather Hunt

Erin Krupa

Temple A. Walkowiak

Assistant Professors

Robin Keturah Anderson

Kirstin Collette Rogis Busch

Sunghwan Byun

Ruby Ellis

Tamecia Raishaun Jones

Jonee Wilson

Practice/Research/Teaching Professors

Cynthia Page Edgington

Matt Reynolds

Kevin Sutton

Learning & Teaching in STEM (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
EMS 794	Special Problems in Science Teaching (Foundational Learning Theories in STEM Education)		
EMS 791	Contemporary Research and Critical Issues in STEM Education		
Scholar Leader Core Courses		**6**	
ED 755	Scholar Leader: Diversity and Equity in Schools and Communities		
ED 756	Scholar Leader: Systemic Change in Education		
Research Methods Courses		**15**	
ED 711	Applied Quantitative Methods in Education II		
ED 730	Introduction to Qualitative Research in Education (or equivalent)		
ED 750	Mixed Methods Research in Education		
or ED 731	Advanced Qualitative Research and Data Analysis in Education		
ED 731	Advanced Qualitative Research and Data Analysis in Education [1]		
or ED 712	Survey Methods in Educational Research		
or ED 750	Mixed Methods Research in Education		
or ED 795	Special Topics in Education Research		
EAC 895	Doctoral Dissertation Research		
Dissertation Research		**9-12**	

EMS 895	Doctoral Dissertation Research	
Program Area of Study Courses		**24-30**
Select coursework based on "Program Areas of Study" listed below		
Total Hours		**60-72**

[1] Students may also select from a design-based research course or courses in the Department of Statistics or Psychology at the level 500 or above (e.g., ST 505, PSY 880) approved in conjunction with the academic committee.

Program Areas of Study

Engineering and Technology Education

Code	Title	Hours	Counts towards
Required Courses		**15**	
TED 751	Technology Education: A Discipline		
TED 752	Curricula for Emerging Technologies		
TED 755	Developing and Implementing Technology Education		
TED 756	Planning of Change in TED		
TED 758	Teaching Creative Problem Solving		
Specialty Courses		**15**	
Specialty Courses are determined in conjunction with the academic committee			
Total Hours		**30**	

Mathematics and Statistics Education

Code	Title	Hours	Counts towards
Foundations Course		**3**	
Select one of the following:			
EMS 770	Foundations Of Mathematics Education		
EMS/ST 7**	Foundations of Statistics Education (to be approved by the ABGS Fall 2021)		
Teaching and Learning Course		**3**	
Select one of the following:			
EMS 711	Research on the Teaching and Learning of Math at Secondary and Early College Levels		
EMS 712	Teaching Mathematics In Elementary and Junior High School		
Additional Courses		**6**	
Select two of the following: [2]			
EMS 704	Curriculum Development and Evaluation In Science and Mathematics		
EMS 705	Education and Supervision Of Teachers Of Mathematics and Science		
EMS 792	Special Problems in Math Teaching		
Experiences in Mathematics Education		**3**	
Select one of the following: [3]			
EMS 841	Practicum In Science and Mathematics Education		
EMS 851	Internship In Mathematics and Science Education		
Seminars and Preliminary Exams		**3**	
EMS 802	Seminar In Mathematics Education ((Intro Seminar in Mathematics Education--1 credit, taken within one of the first two semesters at beginning of program))		
EMS 802	Seminar In Mathematics Education ((Advanced Seminar in Mathematics Education-1 credit, taken near end of program))		

EMS 890	Doctoral Preliminary Exam	
Specialty Courses		**6**
Specialty Courses are determined in conjunction with the academic committee		
Total Hours		**24**

[2] Any course not chosen in Foundations or Teaching and Learning categories.

[3] These experiences are planned in coordination with an advisor and are meant to enhance a student's applicable experience in educational settings This could be one experience of 3 hours or any combination of hours.

Science Education

Code	Title	Hours	Counts towards
Required Courses		**12**	
EMS 732	Theoretical and Critical Perspectives of Science Education		
EMS 775	Foundations Of Science Education		
EMS 832	Research Applications in Science Education		
EMS 851	Internship In Mathematics and Science Education		
Specialty Courses		**12**	
Specialty Courses are determined in conjunction with the academic committee [2]			
Total Hours		**24**	

[2] Science Education PhD requires 18 master's level science courses minimum from all graduate work. This may be waived by the committee if determined to be sufficient based on previous Master's coursework and sufficient hours, and if the total number of required hours are reached. Students will take graduate courses (500 or above level) that deepen or broaden their understanding of issues related to the focus of their research and grade level, and future career interests. Courses should be chosen in consultation with an advisor.

Faculty

Full Professors

Margaret R. Blanchard

Sarah J. Carrier

Aaron Catron Clark

Jo-Ann D. Cohen

Karen Flanagan Hollebrands

Carla Johnson

Melissa Gail Jones

Hollylynne Stohl Lee

Soonhye Park

Eric N. Wiebe

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Sunghwan Byun

Ruby Ellis

Tamecia Raishaun Jones

Jonee Wilson

Practice/Research/Teaching Professors

Cynthia Page Edgington

Matt Reynolds

Kevin Sutton

Learning Design & Technology

The department of Teacher Education and Learning Sciences offers master's degrees in Learning Design and Technology. These master's programs prepare education professionals to lead digital learning programs, design digital learning environments, and inquire into digital learning solutions to continuously refine instruction and improve student learning.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved by the Council for the Accreditation of Educator Preparation (CAEP). Graduates of this program holding a North Carolina teaching license are eligible to add the 079 computer

teacher endorsement and/or 077 technology specialist endorsement to their license.

Admission Requirements

Learning Design & Technology: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters. The Graduate School requires a 3.0 in the undergraduate program. TOEFL or IELTS scores for international applicants whose first language is not English.

Master's Degree Requirements

Learning Design & Technology: A minimum of 30 course credit hours. For the M.S. degree, a minimum of 36 hours is required. The M.S. degree requires a thesis and final oral examination approved by the graduate committee.

Degrees

- Learning Design & Technology (MEd) (p. 325)
- Learning Design & Technology (MS) (p. 326)

Full Professors

Kevin M. Oliver

Associate Professors

Deniz Eseryel

Assistant Professors

Shiyan Jiang

Practice/Research/Teaching Professors

Shaun B. Kellogg

Julia O'Neal McKeown

Heather Purichia

Mark Justin Samberg

Learning Design & Technology (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ECI 511	Introduction to Learning Design and Technology		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 517	Theoretical Foundations of Advanced Learning Environments		
ECI 652	Field-Based Applications of Learning Design and Technology		
Elective Courses		**15**	
Select a minimum of 15 credit hours of the following courses:			
ECI 502	Technology Program Evaluation		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 518	Digital Learning Program and Staff Development		
ECI 721	Technology and Informal Learning Environments		
ECI 722	Theory and Research in Distance Education		
Total Hours		**30**	

Full Professors

Kevin M. Oliver

Associate Professors

Deniz Eseryel

Assistant Professors

Shiyan Jiang

Practice/Research/Teaching Professors

Shaun B. Kellogg

Julia O'Neal McKeown

Heather Purichia

Mark Justin Samberg

Learning Design & Technology (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECI 511	Introduction to Learning Design and Technology		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 517	Theoretical Foundations of Advanced Learning Environments		
Elective Courses		**12**	
Select a minimum 12 credit hours of the following courses:			
ECI 502	Technology Program Evaluation		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 518	Digital Learning Program and Staff Development		
ECI 519	Special Problems in Learning Design and Technology		
ECI 721	Technology and Informal Learning Environments		
ECI 722	Theory and Research in Distance Education		
Research Methods / Thesis Courses		**12**	
Select a minimum 12 credit hours of the following courses:			
ECI 510	Research Applications In Curriculum and Instruction		
ECI 586	Introduction to Learning Analytics		
ECI 587	Machine Learning in Education		
ECI 588	Text Mining in Education		
ECI 589	Analyzing Learning Networks		
ECI 695	Master's Thesis Research		
ST 511	Statistical Methods For Researchers I		
Total Hours		**36**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Full Professors

Kevin M. Oliver

Associate Professors

Deniz Eseryel

Assistant Professors

Shiyan Jiang

Practice/Research/Teaching Professors

Shaun B. Kellogg

Julia O'Neal McKeown

Heather Purichia

Mark Justin Samberg

Mathematics Education

Our mission is to prepare master's degree-seeking students for positions of instructional leadership in Mathematics Education as master teachers of mathematics in middle grades (6-9), high school (9-12) or post-secondary institutions such as community colleges.A master's program is offered that leads to initial teaching licensure. Master's programs are also offered leading to North Carolina M-licensure as a teacher of technology at grades 6-12. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may choose a program to prepare for teaching careers in post-secondary education.

- Master of Education in STEM Education – Mathematics Concentration
- Master of Arts in Teaching – Mathematics Education

Admission Requirements

Applicants for M.S., degrees in mathematics education must submit a completed application specific to the program. Please see the Science, Technology, Engineering and Mathematics (STEM) Education website for details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Master's Degree Requirements

The Master of Science Degree requires a minimum of 36 semester hours of graduate work.

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

- Mathematics Education (MS) (p. 327)
- Mathematics Education (Minor) (p. 328)

Faculty

Full Professors

Jo-Ann D. Cohen

Karen Flanagan Hollebrands

Hollylynne Stohl Lee

Paola Sztajn

Associate Professors

Jessica Heather Hunt

Temple A. Walkowiak

Assistant Professors

Robin Keturah Anderson

Sunghwan Byun

Ruby Ellis

Erin Krupa

Jonee Wilson

Emeritus Faculty

Norman Dean Anderson

Jere Confrey

John Ronald Kolb

Larry W. Watson

Mathematics Education (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
Select four of the following: [1]		12	
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		

EMS 510	Interactions In the Mathematics Classroom	
EMS 573	Design of Tools and Learning Environments in STEM Education	
EMS 580	Teaching Mathematics with Technology	
STEM Education course		3
Mathematical Science courses [2]		15
Elective course		3
Research course		3
Total Hours		**36**

[1] One must be a technology course

[2] 6/15 credit hours may be taken at 400 level

Faculty

Full Professors

Jo-Ann D. Cohen

Karen Flanagan Hollebrands

Hollylynne Stohl Lee

Paola Sztajn

Associate Professors

Jessica Heather Hunt

Temple A. Walkowiak

Assistant Professors

Robin Keturah Anderson

Sunghwan Byun

Ruby Ellis

Erin Krupa

Jonee Wilson

Emeritus Faculty

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Jere Confrey

John Ronald Kolb

Larry W. Watson

Mathematics Education (Minor)

Plan Requirements

Master's Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select three of the following courses:			
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		
EMS 580	Teaching Mathematics with Technology		
EMS 573	Design of Tools and Learning Environments in STEM Education		
Total Hours		**9**	

PhD Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select three or four courses from the following:			
EMS 704	Curriculum Development and Evaluation In Science and Mathematics		
EMS 705	Education and Supervision Of Teachers Of Mathematics and Science		
EMS 711	Research on the Teaching and Learning of Math at Secondary and Early College Levels		

EMS 712	Teaching Mathematics In Elementary and Junior High School	
EMS 770	Foundations Of Mathematics Education	
EMS 790	Foundational Learning Theories in STEM Education (course pending Admin Board approval 2021)	
EMS 791	Contemporary Research and Critical Issues in STEM Education	
Select one or no courses from the following:		
EMS 510	Interactions In the Mathematics Classroom	
EMS 513	Teaching and Learning of Algebraic Thinking	
EMS 514	Teaching and Learning of Geometric Thinking	
EMS 519	Teaching and Learning of Statistical Thinking	
EMS 580	Teaching Mathematics with Technology	
EMS 573	Design of Tools and Learning Environments in STEM Education	
Total Hours		**12**

Faculty

Full Professors

Jo-Ann D. Cohen

Karen Flanagan Hollebrands

Hollylynne Stohl Lee

Paola Sztajn

Associate Professors

Jessica Heather Hunt

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Assistant Professors

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Jere Confrey

John Ronald Kolb

Larry W. Watson

School Administration

NCSU's Master of School Administration (MSA) program is the top-ranked school leadership program in North Carolina and one of only six programs nationally to have been designated as exemplary by the University Council for Educational Administration. The cohort-based program prepares graduates to assume building-level leadership positions in schools (public, private, and charter) as assistant principals and principals and leads to principal licensure.

Admission Requirements

Personal statement including career goals and aspirations; transcripts; teaching experience in K-12 schools (three years preferred); resume; three letters of recommendation (one recommendation is to be from current supervisor); minimum 3.0 undergraduate GPA (preferred); participate in Candidate Assessment Day.

All application materials must be submitted through the Graduate School's online application process only. No hard copies will be accepted. Because this program is cohort-based, no deferrals of admission are permitted.

Degrees

- School Administration (MR) (p. 330)

Full Professors

Bonnie C. Fusarelli

Lance D. Fusarelli

Associate Professors

Lisa R. Bass

Anna Margaret Jacob

Assistant Professors

Jennifer Baucom Ayscue

Timothy Arthur Drake

Emeritus Faculty

Paul F. Bitting

Raymond G. Taylor Jr.

Practice/Research/Teaching Professors

Patricia Andrews Ashley

Brenda D. Champion

William Harrison

Gregory Eugene Hicks

Henry Johnson

Francine Piscitelli Riddick

Michael Ward

Cathy Sue Williams

School Administration (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**43**	
ELP 515	Education and Social Diversity		
ELP 518	Introduction To Education Law		
ELP 550	Principles of Educational Leadership and Empowerment		
ELP 551	Context and Challenges of School Improvement		
ELP 552	School-Based Planning, Management, and Evaluation in Professional Learning Communities		
ELP 553	Organizational Management I: Human Resource Management in K-12 Education		
ELP 554	Organizational Management II: Resource Support and Sustainability in K-12 Education		
ELP 595	Special Topics (Data Use for School Leaders)		
ELP 595	Special Topics (Leadership Foundations)		
ELP 595	Special Topics (School & Community Engagement)		
ELP 595	Special Topics (Culture & Collaboration)		
ELP 620	Special Problems In Education		
ELP 651	Internship In Educational Leadership and Program Evaluation		
Total Hours		**43**	

Full Professors

Bonnie C. Fusarelli

Lance D. Fusarelli

Associate Professors

Lisa R. Bass

Anna Margaret Jacob

Assistant Professors

Jennifer Baucom Ayscue

Timothy Arthur Drake

Emeritus Faculty

Paul F. Bitting

Raymond G. Taylor Jr.

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Brenda D. Champion

William Harrison

Gregory Eugene Hicks

Henry Johnson

Francine Piscitelli Riddick

Michael Ward

Cathy Sue Williams

School Counseling

All master's degree programs (on-campus and online formats) are accredited by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024.

The doctoral program concentration in counseling and counselor education is accredited by the by the Council for Accreditation of Counseling and Related Educational Programs through March 31, 2024.

Admission Requirements

Admissions Requirements for Master's Programs (on-campus and online programs):

- Completed online application, resume, personal statement/goals, and non-refundable application fee
- We are no longer requiring the GRE Scores/MAT Scores for our masters program
- 3 recommendations from people who know your academic record and potential for graduate study (letters should be uploaded online)
- Official transcripts of all post-secondary education
- Official** statement of English Proficiency (TOEFL) for international students

Applicants are expected to have an undergraduate GPA of 3.0 or higher.

Master's Degree Requirements

For master's degree concentrations, admission is limited in order to maintain faculty student interaction in didactic classes, for supervision in practica and for informal contact. Generally, class size averages between 20 and 25 in didactic, 4-5 in practica, and the advising ratio is approximately l to 10.

The Master's of Education Degree (M.Ed.) is primarily a practitioner-oriented master's and is offered in the on-campus program or DE online program. The Department of Counselor Education offers three programs of study leading to the Master of Education Degree:

- Clinical Mental Health Counseling (p. 280),
- College Counseling and Student Development (p. 281), and
- School Counseling (p. 332).

Degrees earned will be distributed as: "Master of Education" without program of study specifications. Programs of study will only be printed on transcripts.

These programs of study require a minimum of 60 credits. Students who complete the program will be eligible to sit for the National Counselor Examination (NCE). Students in the School Counseling program are also eligible for licensure as school counselors in North Carolina (providing they pass the counseling PRAXIS examination).

Student Financial Support

At NC State, our goal is to assure that no student who can benefit from an NC State education be denied that opportunity due to finances. We are committed to allocating our financial aid resources to help the broadest range of students.

Graduate students may apply for Federal Subsidized and Unsubsidized Stafford Loans, and for Federal Work-Study employment. Qualified graduate students pursuing masters or doctoral degrees may also apply for fellowships, assistantships and other awards offered through individual colleges and the Graduate School.

Degrees

- School Counseling (MEd) (p. 332)

Faculty

Stanley B Baker

Marc A. Grimmett

Sylvia Christine Maria Nassar

Jose' A. Picart

Siu-Man Ting

Adria Shipp Dunbar

Brean'a Parker

Cristina Braga

Nicole Childs

Helen Lupton-Smith

Rolanda Mitchell

Angela Smith

Teri Tilford

Elizabeth Vincent

Emeritus Faculty

Edwin R. Gerler Jr.

Richard Tyler-Walker

Amanda Allen

Clinton Bolton

Monica Osbourne

School Counseling (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**60**	
ECD 510	Orientation to Professional Counseling, Identity, and Ethics		
ECD 524	Career Counseling and Development		
ECD 525	Multicultural Counseling		
ECD 530	Theories and Tech of Counseling		
ECD 533	Int Sch Counseling		
ECD 539	Group Counseling		
ECD 540	Gender Issues In Counseling		
ECD 541	Substance Abuse and Counseling		
ECD 542	Research in Counseling		
ECD 545	Counseling Couples and Families		
ECD 546	Crisis Interventions in Counseling		
ECD 561	Strategies for Clinical Assessment in Counseling		
ECD 562	Techniques in Counseling		
ECD 575	Multicultural Lifespan Development		
ECD 642	Practicum In Counseling		
ECD 651	Internship in School Counseling *		
Total Hours		**60**	

* ECD 651 Internship in School Counseling covers over two semesters, Fall and Spring 6 credits each, 12 credit hours in total

Faculty

Stanley B Baker

Marc A. Grimmett

Sylvia Christine Maria Nassar

Jose' A. Picart

Siu-Man Ting

Adria Shipp Dunbar

Brean'a Parker

Cristina Braga

Nicole Childs

Helen Lupton-Smith

Rolanda Mitchell

Angela Smith

Teri Tilford

Elizabeth Vincent

Emeritus Faculty

Edwin R. Gerler Jr.

Richard Tyler-Walker

Amanda Allen

Clinton Bolton

Monica Osbourne

Science Education

The Science Education Program offers a Master’s of STEM Education (MEd) Distance Education with a Concentration in Science Education. We prepare educators and researchers for positions as teachers, leaders, and science educators of the highest quality at the university, community college, middle and/or high school level, or informal science education centers. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty in Science Education, and in academic discipline areas including: biological sciences, chemistry, earth science, environmental science, interdisciplinary science or physics.

Our STEM Ed Master's program (MEd) leads to North Carolina M-licensure as a teacher of science at grades 6-12 or advanced credentials for informal educators. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may design a program to prepare for teaching careers in post-secondary education.

Some of our students elect to move directly from our master's into our doctoral program in Learning and Teaching in STEM – Science Education. These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

1. scholarly inquiry and discourse in science education,
2. preparation of K-12 teachers and informal science educators,
3. instruction and development issues in K-16, and
4. leadership positions.

Admission Requirements

Applicants for the STEM MEd degree with a concentration in science education must submit a completed application specific to the program. No GRE is required. Please see the Science Education website for details. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Student Financial Support

A small number of scholarships may be available through the College of Education or NC State University. For those who apply for financial aid, there may be some grants available through the university. Please discuss these opportunities directly with program area faculty.

Degrees

- Science Education (MS) (p. 333)
- Science Education (Minor) (p. 334)

Faculty

Full Professors

Margaret R. Blanchard

Carla Johnson

Melissa Gail Jones

Soonhye Park

Eric N Wiebe

Associate Professors

Sarah J. Carrier

Cesar Delgado

Assistant Professors

K. C. Rogis Busch

Practice/Research/Teaching Professors

W. Matthew Reynolds

Emeritus Faculty

Glenda S. Carter

John H. Wheatley

Science Education (MS)

Degree Requirements

The College of Education is no longer admitting students for the Master of Science in Elementary Education degree program.

Degrees earned will be distributed as: "Master of Science in Science Education" without specialty specifications.

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 592	Special Problems In Mathematics Teaching (Design of Tools and Learning Environments in STEM Education)		
Specialty Courses		**27**	
Science Education			
EMS 521	Advanced Methods in Science Education I		
EMS 522	Advanced Methods in Science Education II		
EMS 531	Introduction to Research in Science Education		
EMS 575	Foundations Of Science Education		
Specialty Content			
Select specialty content courses approved in conjunction with the academic committee			
Research Courses		**6**	
Select a research elective approved in conjunction with the academic committee			

EMS 695	Master's Thesis Research	
Total Hours		**36**

Faculty

Full Professors

Margaret R. Blanchard

Carla Johnson

Melissa Gail Jones

Soonhye Park

Eric N Wiebe

Associate Professors

Sarah J. Carrier

Cesar Delgado

Assistant Professors

K. C. Rogis Busch

Practice/Research/Teaching Professors

W. Matthew Reynolds

Emeritus Faculty

Glenda S. Carter

John H. Wheatley

Science Education (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Margaret R. Blanchard

Carla Johnson

Melissa Gail Jones

Soonhye Park

Eric N Wiebe

Associate Professors

Sarah J. Carrier

Cesar Delgado

Assistant Professors

K. C. Rogis Busch

Practice/Research/Teaching Professors

W. Matthew Reynolds

Emeritus Faculty

Glenda S. Carter

John H. Wheatley

Science, Technology, Engineering, and Mathematics Education

The STEM Education Program offers a Master's of Education (MEd) with concentration in Science Education, Engineering and Technology Education, and Mathematics and Statistics Education. We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty and in academic discipline areas.

Our Master's program (MEd) leads to North Carolina M-licensure as a teacher of science at grades 6-12 or advanced credentials for informal

educators. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may design a program to prepare for teaching careers in post-secondary education.

Some of our students elect to move directly from our master's into our doctoral program in Learning and Teaching in STEM – Science Education, Engineering and Technology Education or Mathematics and Statistics Education. These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

1. scholarly inquiry and discourse in science education,
2. preparation of K-12 teachers and informal science educators,
3. instruction and development issues in K-16, and
4. leadership positions.

Admission Requirements

Applicants for the M.Ed. degree must submit a completed application specific to the program concentration. No GRE is required. Please see the concentration degree requirements pages for more information:

- Science Education (p. 337)
- Engineering and Technology Education (p. 336)
- Mathematics and Statistics Education (p. 336)

The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific concentration.

Student Financial Support

A small number of scholarships may be available through the College of Education or NC State University. For those who apply for financial aid, there may be some grants available through the university. There are also federal loan forgiveness programs. Please discuss these opportunities directly with program area faculty.

Degrees

- Science, Technology, Engineering, and Mathematics Education (MEd) (p. 335)
- Science, Technology, Engineering, and Mathematics Education (MEd): Engineering and Technology Education Concentration (p. 336)
- Science, Technology, Engineering, and Mathematics Education (MEd): Mathematics & Statistics Education Concentration (p. 336)
- Science, Technology, Engineering, and Mathematics Education (MEd): Science Education Concentration (p. 337)
- Mathematics Teaching and Learning (Certificate) (p. 337)

Full Professors

Margaret R. Blanchard

Aaron Catron Clark

Karen Flanagan Hollebrands

Carla Johnson

Melissa Gail Jones

Hollylynne Stohl Lee

Soonhye Park

Associate Professors

Sarah J. Carrier

Cesar Delgado

Cameron DeLeon Denson

Jessica Heather Hunt

Temple A. Walkowiak

Assistant Professors

Robin Keturah Anderson

Kirstin Collette Rogis Busch

Sunghwan Byun

Ruby LaTeshia Ellis

Tamecia Raishaun Jones

Erin Krupa

Jonee Wilson

Practice/Research/Teaching Professors

Cynthia Page Edgington

W. Matthew Reynolds

Kevin Gregory Sutton

Professor emeritus

Jere Confrey

Science, Technology, Engineering, and Mathematics Education (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 573	Design of Tools and Learning Environments in STEM Education		
Specialty Courses		**15**	

Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee	
Concentration Courses	**12**
See "Concentration Requirements" listed below	
Total Hours	**30**

Science, Technology, Engineering, and Mathematics Education (MEd): Engineering and Technology Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 573	Design of Tools and Learning Environments in STEM Education		
Specialty Courses		**15**	
Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee			
Concentration Courses		**12**	
See "Concentration Requirements" listed below			
Total Hours		**30**	

Concentration Requirements

Code	Title	Hours	Counts towards
Concentration Courses [1]		**12**	
Select four courses from the following:			
EMS 592	Special Problems In Mathematics Teaching (Design of Tools and Learning Environments in STEM Education)		
TED 530	Foundations for Teaching Technology		
TED 558	Teaching Creative Problem Solving		
TED 552	Curricula for Emerging Technologies		
TED 555	Developing and Implementing Technology Education		

[1] Generally Engineering and Education courses offered online

Science, Technology, Engineering, and Mathematics Education (MEd): Mathematics & Statistics Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 573	Design of Tools and Learning Environments in STEM Education		
Specialty Courses		**15**	
Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee			
Concentration Courses		**12**	
See "Concentration Requirements" listed below			
Total Hours		**30**	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select four courses from the following:			
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		

EMS 580	Teaching Mathematics with Technology

Science, Technology, Engineering, and Mathematics Education (MEd): Science Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 573	Design of Tools and Learning Environments in STEM Education		
Specialty Courses		**15**	
Select a minimum of five courses in Science, Mathematics, Engineering, or Education approved in conjunction with the academic committee			
Concentration Courses		**12**	
See "Concentration Requirements" listed below			
Total Hours		**30**	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
EMS 521	Advanced Methods in Science Education I		
EMS 522	Advanced Methods in Science Education II		
EMS 531	Introduction to Research in Science Education		
EMS 575	Foundations Of Science Education		

Mathematics Teaching and Learning (Certificate)

The Graduate Certificate in Mathematics Teaching and Learning is an online program that focuses on developing knowledge and instructional approaches in teaching mathematics. The program will primarily serve practicing teachers in middle school through college settings, or those preparing for careers in such settings, who want to expand their expertise related to teaching and learning mathematics. Students will learn how to apply research-based understandings of students' thinking, pedagogical approaches, and broader educational issues (e.g., discourse and equity) to inform practices of teaching content such as geometry, algebra, and statistics.

Plan Requirements

Code	Title	Hours	Counts towards
Select four of the following:		12	
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		
EMS 580	Teaching Mathematics with Technology		
Total Hours		**12**	

Special Education

The department of Teacher Education and Learning Sciences offers master's degrees in Special Education. The Special Education program at NC State prepares students for excellence in teaching, assessment, curriculum development, classroom and behavior management, teaching students with high incidence disabilities, evaluation and professional leadership, as well as other areas of service to students with disabilities and to schools and agencies. Our nationally recognized faculty provides excellent teaching, leadership opportunities, and high standards of performance.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Special Education: A 500-800 word statement describing professional goals is required, along with transcripts and reference letters.
Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience.
A match to resources and faculty areas of interest and expertise is necessary, since the program is competitive. The Graduate School requires a 3.0 in the undergraduate program.

Degrees

- Special Education (MEd) (p. 338)
- Special Education (MS) (p. 339)
- Special Education (Minor) (p. 339)

- Special Education (Certificate): Multi-Tiered Systems of Support (MTSS) (p. 340)

Faculty

Full Professors

Cathy L. Crossland

Edward J. Sabornie

Associate Professors

Jessica Heather Hunt

Assistant Professors

Jamie Nicole Pearson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Kristin Hofmann

Emeritus Faculty

Douglas A. Cullinan

Susan Sinclair Osborne

Special Education (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECI 572	Resource Teaching In Special Education	3	
ECI 573	Applied Behavior Analysis & Positive Behavior Intervention and Support in Schools	3	
ECI 581	Educational Diagnosis and Prescription For Children With Exceptionalities	3	
ECI 585	Education of Children with Exceptionalities	3	
ECI 681	Seminar in Special Education Literacy	3	
ECI 658	Internship In Special Education	1-6	
ECI 571	Instructional Strategies for Students with Disabilities	3	
ECI 576	Teaching Functional and Life Skills to Students with Disabilities	3	
ECI 584	Intervention for Behavior Problems of Students with Disabilities	3	
ECI 682	Spe Ed Seminar in Teaching Numerical Concepts	3	
Total Hours		**28-33**	

Faculty

Full Professors

Cathy L. Crossland

Edward J. Sabornie

Associate Professors

Jessica Heather Hunt

Assistant Professors

Jamie Nicole Pearson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Kristin Hofmann

Emeritus Faculty

Douglas A. Cullinan

Susan Sinclair Osborne

Special Education (MS)

Degree Requirements

The College of Education is no longer admitting students in the Master of Science in Special Education degree program.

Code	Title	Hours	Counts towards
Required Courses		**18**	
ECI 572	Resource Teaching In Special Education		
ECI 573	Applied Behavior Analysis & Positive Behavior Intervention and Support in Schools		
ECI 581	Educational Diagnosis and Prescription For Children With Exceptionalities		
ECI 585	Education of Children with Exceptionalities		
ECI 681	Seminar in Special Education Literacy		
ECI 658	Internship In Special Education		
Methods Courses		**12**	
ECI 571	Instructional Strategies for Students with Disabilities		
ECI 576	Teaching Functional and Life Skills to Students with Disabilities		
ECI 584	Intervention for Behavior Problems of Students with Disabilities		
ECI 682	Spe Ed Seminar in Teaching Numerical Concepts		
Research Course		**6**	
Select a research elective approved in conjunction with the academic committee			
ECI 695	Master's Thesis Research		
Total Hours		**36**	

Faculty

Full Professors

Cathy L. Crossland

Edward J. Sabornie

Associate Professors

Jessica Heather Hunt

Assistant Professors

Jamie Nicole Pearson

Practice/Research/Teaching Professors

Valerie Ness Faulkner

Kristin Hofmann

Emeritus Faculty

Douglas A. Cullinan

Susan Sinclair Osborne

Special Education (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Cathy L. Crossland

Edward J. Sabornie

Associate Professors

Jessica Heather Hunt

Assistant Professors

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Susan Sinclair Osborne

Special Education (Certificate): Multi-Tiered System of Supports (MTSS)

The Special Education MTSS Online Certificate is a series of four (4) online courses designed to prepare individuals with necessary knowledge and skills related to policies and practices to support the implementation of MTSS. Course content provides enrollees with evidence-based practices and knowledge of tiered intervention services in the context of preparing effective teachers, administrators, and allied professionals who work at the local education agency or state education agency levels. The program is a portal through which participants may ultimately pursue a Master of Education (M.Ed.) or Master of Arts in Teaching (MAT), and/or licensure in special education.

The four online courses in the GCSE:MTSS represent 12 credit hours of graduate-level coursework. No transfer credits from other institutions are allowed to substitute for any of the four courses in this program. All courses must be completed at NC State.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
ECI 585	Education of Children with Exceptionalities		
ECI 571	Instructional Strategies for Students with Disabilities		
ECI 573	Applied Behavior Analysis & Positive Behavior Intervention and Support in Schools		
Elective Course		**3**	
ECI 584	Intervention for Behavior Problems of Students with Disabilities		
or ECI 576	Teaching Functional and Life Skills to Students with Disabilities		
Total Hours		**12**	

Faculty

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Teacher Education and Learning Sciences

The Ph.D. program in the Department of Teacher Education and Learning Sciences is primarily designed to prepare students for roles as researchers and educators in higher education and industry, or for instructional leadership at school district and state levels. Six program areas of study (focus) are offered by the department: Educational Equity;

Educational Psychology; Elementary Learning Sciences; Learning, Design, & Technology; Literacy & English Language Arts; and Social Studies Education.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved by the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Teacher Education and Learning Sciences: A 500-800 word statement describing professional goals and research interests is required, along with transcripts and reference letters. Some areas of study require that applicants be qualified to hold a baccalaureate-level teaching license or have teaching experience. A match to resources and faculty areas of interest and expertise is necessary since the program is competitive. The Graduate School requires a 3.0 in the undergraduate program. GRE scores not more than five years old are required for the doctoral program.

Doctoral Degree Requirements

Teacher Education and Learning Sciences: A minimum of 72 course credit hours beyond a bachelor's degree is required. For students with a master's degree, at least 60 new hours must be taken after the student matriculates into the doctoral program. The 60-hour program includes 12 hours of scholar leader courses (college and departmental levels), 15 hours of research, 24 hours of program area specialty courses, and 9 hours of dissertation credit.

Student Financial Support

Teaching and Research Assistantships are available on a limited basis.

Degrees

- Teacher Education and Learning Sciences (PhD) (p. 342)
- Teacher Education and Learning Sciences (Minor) (p. 342)
- Learning Analytics (Certificate) (p. 343)

Full Professors

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Edwin R. Gerler Jr.

Lawrence Keith Jones

Susan Sinclair Osborne

Carol A. Pope

Ruie J. Pritchard

Norman A. Sprinthall

Lois M. Thies-Sprinthall

Ellen S. Vasu

Teacher Education and Learning Sciences (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
ED 795	Special Topics in Education Research (Diversity and Equity in Schools and Communities)	3	
ED 795	Special Topics in Education Research (Systemic Change in Education and Society)	3	
Select 15 credit hours of the following:		15	
ED 710	Applied Quantitative Methods in Education I		
ED 711	Applied Quantitative Methods in Education II		
ED 730	Introduction to Qualitative Research in Education		
ED 712	Survey Methods in Educational Research		
ED 731	Advanced Qualitative Research and Data Analysis in Education		
ED 750	Mixed Methods Research in Education		
Additional research methods courses			
EAC 895	Doctoral Dissertation Research	9	
ECI 709	Special Problems In Curriculum and Instruction (Seminar in Teacher Education)	3	
ECI 709	Special Problems In Curriculum and Instruction (Seminar in Learning Sciences)	3	
Program Area Courses [1]		24	
Total Hours		**60**	

[1] Determined by Program Area and consultation with Advisor

TEXT

Teacher Education and Learning Sciences (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

TEXT

Learning Analytics (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECI 586	Introduction to Learning Analytics	3	
ECI 587	Machine Learning in Education	3	
ECI 588	Text Mining in Education	3	
ECI 589	Analyzing Learning Networks	3	
Total Hours		**12**	

Teaching

The Master of Arts in Teaching (MAT) program is an accelerated program with a 100% online option that will prepare you to apply your experience to make a difference from your first day in the classroom, whether you're teaching in-person, remotely or both. The content areas being served by the MAT program are:

- Secondary Math, Science, Social Studies, and English;
- Middle Grades Math, Science, Social Studies, and Language Arts;
- English as a Second Language;
- Special Education;
- Technology Education and Elementary Education.

The NC Department of Public Instruction has conferred accreditation to the graduate programs in Teacher Education and Learning Sciences. The College of Education is approved any the Council for the Accreditation of Educator Preparation (CAEP).

Admission Requirements

Applicants must have:

1. a four-year degree from a college or university that holds regional accreditation, such as SACS;
2. 3.00 GPA or higher in prior work, as required by the Graduate School;
3. an undergraduate degree in the content area/discipline or 24 semester hours/credits in content relevant to the area in which you wish to teach (if you have fewer than 24 hours in a relevant content field, or if your course work does not prepare you adequately to teach the North Carolina curriculum, you may be assigned additional course work to overcome the deficiency).

Applications require original transcripts, 3 letters of recommendation (one of which should speak to teaching potential), a personal essay stating applicant’s background and goals, GRE scores are only required if undergraduate GPA is below 3.0 (and TOEFL if you have international citizenship), and a completed online application.

Master's Degree Requirements

A total of 30-33 credit hours must be earned for completion of the degree, depending on the particular licensure area. These hours include student teaching for non-lateral entry students.

Student Financial Support

Financial aid is available.

Degrees

- Teaching (MA) (p. 344)
- Teaching (MA): Elementary Education Concentration (p. 346)
- Teaching (MA): English as a Second Language Concentration (p. 347)
- Teaching (MA): English Education Concentration (p. 348)
- Teaching (MA): K-12 Reading Concentration (p. 350)
- Teaching (MA): Math Education Concentration (p. 351)
- Teaching (MA): Middle Grades Education Concentration (p. 353)
- Teaching (MA): Middle Grades Math Concentration (p. 354)
- Teaching (MA): Middle Grades Science Concentration (p. 356)
- Teaching (MA): Science Education Concentration (p. 358)
- Teaching (MA): Social Studies Education Concentration (p. 359)
- Teaching (MA): Special Education Concentration (p. 361)
- Teaching (MA): Technology Education Concentration (p. 362)
- Teaching (Minor) (p. 363)

Faculty

Full Professors

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Teaching (MA)

Master of Art Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		
Concentration Requirements		**15-18**	
Select a concentration listed below and select the "Concentration Requirements" in conjunction with the academic committee			
Total Hours		**30-33**	

Concentrations for the Master of Arts in Teaching

- Elementary Education (p. 346)
- English as a Second Language (p. 347)
- English Education (p. 348)
- K-12 Reading (p. 350)
- Math Education (p. 351)
- Middle Grades Education (p. 353)
- Middle Grades Math (p. 354)
- Middle Grades Science (p. 356)
- Science Education (p. 358)
- Social Studies Education (p. 359)
- Special Education (p. 361)
- Technology Education (p. 362)

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Teaching (MA): Elementary Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
ELM 515	Instructional Practice in Schools I		
ELM 516	Instructional Practice in Schools II		
ELM 571	Language Arts, New Literacies and Media for Initial License		
ELM 572	Methods for Teaching Reading in the Elementary Classroom for Initial License		
ELM 573	Methods for Teaching Elementary School Science for Initial License		
ELM 574	Methods for Teaching Mathematics in the Elementary Classroom for Initial License		
ELM 575	Social Studies in the Elementary School for Initial License		
Total Hours		**33**	

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Ruie J. Pritchard

Teaching (MA): English as a Second Language Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ECI 527	Methods and Materials in Teaching English as a Second Language		
ECI 536	Perspectives on English as a New Language		
ECI 541	Reading In the Content Areas		
FL 524	Linguistics for ESL Professionals		
ELM 537	Teaching Children's Literature		
or ELM 572	Methods for Teaching Reading in the Elementary Classroom for Initial License		
or ECI 524	Theory and Research in Global Learning		
Total Hours		**30**	

Faculty

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Ruie J. Pritchard

Teaching (MA): English Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		

ED 570	Classroom Action Research
ED 571	Inquiry and Professional Development
ED 569	Teaching Internship: MAT
ED 572	Teacher Leadership

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 541	Reading In the Content Areas		
ECI 528	Strategies for Teaching English in Secondary Schools		
ECI 522	Trends and Issues in English Language Arts Education		
or ECI 524	Theory and Research in Global Learning		
or ECI 546	New Literacies & Media		
Total Hours		**30**	

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Teaching (MA): K-12 Reading Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ECI 550	Foundations Of Middle Years Education		
ECI 509	Special Problems in Curriculum and Instruction		
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 541	Reading In the Content Areas		
Total Hours		**30**	

Faculty

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Emeritus Faculty

Ruie J. Pritchard

Teaching (MA): Math Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select four of the following courses:			
EMS 580	Teaching Mathematics with Technology		
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		
EMS 570 & EMS 572	Methods and Materials for Teaching Mathematics and Teaching Mathematics Topics in Senior High School (must be taken together)		
Mathematical Science Courses		**6**	
Select a minimum of six hours of Mathematical Science courses at the 400- or 500-level approved in conjunction with the academic committee – see "Mathematical Science Courses" listed below			
Total Hours		**33**	

Mathematical Science Courses

Code	Title	Hours	Counts towards
Select a minimum of six hours of courses listed below:		**6**	
MA 402	Mathematics of Scientific Computing	3	
MA 405	Introduction to Linear Algebra	3	
MA 493	Special Topics in Mathematics	1-6	
MA 501	Advanced Mathematics for Engineers and Scientists I	3	
MA 502	Advanced Mathematics for Engineers and Scientists II	3	
MA 507	Survey of Real Analysis	3	
MA 508	Survey of Geometry	3	
MA 509	Survey of Abstract Algebra	3	
MA 511	Introduction to Advanced Calculus	3	
MA 513	Introduction To Complex Variables	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 580		3	
MA 591	Special Topics	1-6	
ST 501	Fundamentals of Statistical Inference I	3	
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	

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Emeritus Faculty

Ruie J. Pritchard

Teaching (MA): Middle Grades Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

English / Language Arts Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ECI 550	Foundations Of Middle Years Education		
ECI 520	The Teaching Of Composition		
ECI 521	Teaching Literature For Young Adults		
ECI 509	Special Problems in Curriculum and Instruction		
ECI 541	Reading In the Content Areas		
Total Hours		**30**	

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Emeritus Faculty

Ruie J. Pritchard

Teaching (MA): Middle Grades Math Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select four of the following courses from below:			
EMS 580	Teaching Mathematics with Technology		
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		

EMS 570 & EMS 572	Methods and Materials for Teaching Mathematics and Teaching Mathematics Topics in Senior High School	
Mathematical Science Courses		**6**
Select six hours of Mathematical Science courses at the 400- or 500-level approved in conjunction with the academic committee – see "Mathematical Science Courses" listed below		
Total Hours		**33**

Mathematical Science Courses

Code	Title	Hours	Counts towards
Select six hours of the following courses listed below:		**6**	
MA 402	Mathematics of Scientific Computing	3	
MA 405	Introduction to Linear Algebra	3	
MA 493	Special Topics in Mathematics	1-6	
MA 501	Advanced Mathematics for Engineers and Scientists I	3	
MA 502	Advanced Mathematics for Engineers and Scientists II	3	
MA 507	Survey of Real Analysis	3	
MA 508	Survey of Geometry	3	
MA 509	Survey of Abstract Algebra	3	
MA 511	Introduction to Advanced Calculus	3	
MA 513	Introduction To Complex Variables	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 580		3	
MA 591	Special Topics	1-6	
ST 501	Fundamentals of Statistical Inference I	3	
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	

Faculty

Full Professors

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Linda Smith

Emeritus Faculty

Ruie J. Pritchard

Teaching (MA): Middle Grades Science Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
EMS 505	Methods of Teaching Science I		
EMS 506	Methods of Teaching Science II		
EMS 531	Introduction to Research in Science Education		
EMS 573	Design of Tools and Learning Environments in STEM Education		
Science Methods Courses		**6**	
Select a minimum of six hours of Science Methods courses approved in conjunction with the academic committee – see "Science Methods Courses" listed below			
Total Hours		**33**	

Science Methods Courses

Code	Title	Hours	Counts towards
Select a minimum of six hours of courses listed below:		**6**	
BIO 592	Topical Problems	1-3	
BSC 546	Humans and Disease: Communicable Diseases	3	
EA 506	Water Quality Assessment	3	

EDP 575	Multicultural Lifespan Development	3
EDP 582	Adolescent Development	3
GIS 510	Fundamentals of Geospatial Information Science and Technology	3
GIS 520	Spatial Problem Solving	3
MEA 517	Fundamentals of Climate Change Science	3
MEA 519	Barriers to Climate Change Literacy	3
MEA 549	Principles of Biological Oceanography	3
NTR 500	Principles of Human Nutrition	3
NTR 501	Advanced Nutrition and Metabolism	3
NTR 510	Maternal and Infant Nutrition	3
NTR 515	Comparative Nutrition	3
PY 581	Matter & Interactions for Teachers I	3
PY 582	Matter & Interactions for Teachers II	3

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Teaching (MA): Science Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
EMS 505	Methods of Teaching Science I		
EMS 573	Design of Tools and Learning Environments in STEM Education		
EMS 531	Introduction to Research in Science Education		
EMS 506	Methods of Teaching Science II		
Science / Science Education Courses		**6**	
Select a minimum of six hours of Science and Science Education content courses approved in conjunction with the academic committee			
Total Hours		**33**	

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Teaching (MA): Social Studies Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECI 550	Foundations Of Middle Years Education		
ECI 535	Methods and Materials for Teaching Social Studies in the Middle Grades		
ECI 525	Contemporary Approaches In the Teaching Of Social Studies		
ECI 526	Theory and Research On Teaching and Learning Social Studies		
Select a graduate-level social science course approved in conjunction with the academic committee			
Select one of the following courses:			

ECI 630	Independent Study in Curriculum and Instruction	
ECI 620	Special Problems In Curriculum and Instruction	
ECI 727	Special Problems in Social Studies Education	
ECI 524	Theory and Research in Global Learning	
Total Hours		**33**

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Teaching (MA): Special Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
ECI 571	Instructional Strategies for Students with Disabilities		
ECI 576	Teaching Functional and Life Skills to Students with Disabilities		
ECI 581	Educational Diagnosis and Prescription For Children With Exceptionalities		
ECI 584	Intervention for Behavior Problems of Students with Disabilities		
ECI 585	Education of Children with Exceptionalities		
ECI 681	Seminar in Special Education Literacy		
Total Hours		**33**	

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Teaching (MA): Technology Education Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ED 508	Exploring Diversity in Classroom and Community		
ECI 579	Organization and Behavioral Management of Inclusive Classrooms		
ED 507	Principles of Developing and Interpreting Assessment		
ED 570	Classroom Action Research		
ED 571	Inquiry and Professional Development		
ED 569	Teaching Internship: MAT		
ED 572	Teacher Leadership		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
EMS 505	Methods of Teaching Science I		
EMS 506	Methods of Teaching Science II		
TED 530	Foundations for Teaching Technology		
TED 558	Teaching Creative Problem Solving		
TED 552	Curricula for Emerging Technologies		
TED 555	Developing and Implementing Technology Education		
Total Hours		**33**	

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Teaching (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Technology Education

The Technology Education Program offers a Master's of Education – Distance Education concentration in Technology Education. We prepare educators and researchers for positions as teachers, leaders, and university faculty of the highest quality. We are particularly proud of our emphasis on the use of technology to enhance teaching. Students take courses in their educational specialty, in general professional education, and in academic discipline areas including: computer science, engineering, graphic arts, and statistics.

Our master's program can lead to initial teaching licensure. The program can be designed to lead to North Carolina M-licensure as a teacher of technology at grades 6-9 and/or 9-12. Programs are also available for those seeking advanced graduate-level certification as a teacher. Finally, students may choose a program to prepare for teaching careers in post-secondary education.

Some of our elect to move directly from our master's into our doctoral program in Learning and Teaching in STEM – Technology Education. These students are knowledge-seekers and are eager to pursue educational problems and develop critical thinking skills in a collaborative environment. The programs prepare individuals for positions in their fields of study related to:

- scholarly inquiry and discourse in their discipline,
- preparation of K-12 teachers,
- instruction and development issues in K-16, and
- leadership positions.

Admission Requirements

Applicants for the Master of Education – Distance Ed degree in Technology Education must submit a completed application to the Graduate School. The deadlines for submission of an application, and academic and professional background necessary for admission differ by specific program.

Master's Degree Requirements

Master's Degree programs require a minimum of 30 semester hours of graduate work. Students who choose the M.S. degree may be able to substitute up to six semester hours of thesis research for part of the course load. The M.Ed. degree is online only.

Student Financial Support

A small number of teaching and research assistantships are available, and out-of-state tuition remission may be available for one year for students on assistantships. Please discuss these opportunities directly with program area faculty.

Degrees

- Technology Education (EdD) (p. 365)
- Technology Education (MS) (p. 366)
- Technology Education (MS): Graphic Communication Education Concentration (p. 367)
- Technology Education (Minor) (p. 368)

Faculty

Full Professors

Aaron Catron Clark

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Assistant Professors

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Tameshia Ballard Baldwin

Brian Matthews

Alice Y. Scales

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Johnny L. Crow

V. William DeLuca

Richard Eric Peterson

Robert E. Wenig

Technology Education (EdD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18**	
TED 551/751	Technology Education: A Discipline		
TED 552/752	Curricula for Emerging Technologies		
TED 555/755	Developing and Implementing Technology Education		
TED 558/758	Teaching Creative Problem Solving		
TED 757	Leadership Development in TED		
TED 756	Planning of Change in TED		
Elective Courses		**12**	
Select 12 hours of the following courses:			
TED 530	Foundations for Teaching Technology		
TED 532	Current Trends in Technical Graphics Education		
TED 534	Instructional Design in Technical and Technology Education		
TED 536	Scientific and Technical Visualization: Theory and Practice		
TED 641	Internship in Technology Education [1]		
TED 646	Field-based Research in Technology Education [1]		
TED 709	Seminar in Technology Education		
TED 801	Practicum in Technology Education		
TED 810	Special Topics in Technology Education		
TED 821	Special Problems in Technology Education		
Research Courses		**24-27**	
ED 700	Introduction to Research Design in Education		

ED 710	Applied Quantitative Methods in Education I	
ST 507	Statistics For the Behavioral Sciences I	
ST 508	Statistics For the Behavioral Sciences II	
TED 895	Doctoral Dissertation Research	
Select two of the following courses:		
ED 711	Applied Quantitative Methods in Education II	
ED 730	Introduction to Qualitative Research in Education	
ED 731	Advanced Qualitative Research and Data Analysis in Education	
ED 750	Mixed Methods Research in Education	
ST 505	Applied Nonparametric Statistics	
Minor		**9-12**
Select 9-12 hours from a cognitive area of study approved in conjunction with the academic committee		
Total Hours [2]		**54-62**

1 TED 641 Internship in Technology Education and TED 646 Field-based Research in Technology Education are required for "M" Certification.

2 90 total semester hours are required beyond an undergraduate degree.

Faculty

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Technology Education (MS)

Degree Requirements

The College of Education is no longer admitting students for the Master of Science in Technology Education degree program.

Degrees earned will be distributed as: "Master of Science in Technology Education" without specialty specifications.

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 592	Special Problems In Mathematics Teaching (Design of Tools and Learning Environments in STEM Education)		
Specialty Courses		**27**	
Technology Education			
TED 530	Foundations for Teaching Technology		
TED 552	Curricula for Emerging Technologies		
TED 555	Developing and Implementing Technology Education		
TED 558	Teaching Creative Problem Solving		
Specialty Content			

Select specialty courses approved in conjunction with the academic committee		
Research Courses		**6**
Select a research elective approved in conjunction with the academic committee		
EMS 695	Master's Thesis Research	
Total Hours		**36**

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Technology Education (MS): Graphic Communication Education Concentration

Degree Requirements

The College of Education is no longer admitting students for the Master of Science in Technology Education degree program.

Degrees earned will be distributed as: "Master of Science in Technology Education" without specialty specifications.

Code	Title	Hours	Counts towards
Core Course		**3**	
EMS 592	Special Problems In Mathematics Teaching (Design of Tools and Learning Environments in STEM Education)		
Specialty Courses		**27**	
Technology Education			
TED 530	Foundations for Teaching Technology		
TED 552	Curricula for Emerging Technologies		
TED 555	Developing and Implementing Technology Education		
TED 558	Teaching Creative Problem Solving		
Specialty Content			
Select specialty content courses approved in conjunction with the academic committee			
Research Courses		**6**	
Select a research elective approved in conjunction with the academic committee			
EMS 695	Master's Thesis Research		
Total Hours		**36**	

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Technology Education (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Training & Development

The Master of Education (M.Ed.) degree in Training and Development, a fully online program, is based on a reflective practice approach offering practitioners opportunities to integrate their professional experiences with human resource development knowledge and practice skills. Completing this master's program will give you the professional knowledge and skill required for entry or advancement in instructional design, and instructional, administrative, or evaluation positions that involve performance-based training. Our courses are in alignment with the Association of Talent Development's Core Competency Model.

Our program emphasizes:

- Interaction
- Collaboration
- Team Learning
- Reflective Practice
- Adult Learning

Admission Requirements

Applicants for the M.Ed. degree in Training and Development must complete an application through the Graduate School, submit a personal statement, post-secondary transcripts, and three letters of recommendation. GRE scores are not required. Please see the Training and Development Program website for complete details.

Degrees

- Training & Development (MEd) (p. 369)
- Training & Development (Minor) (p. 370)

Faculty

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Duane Akroyd

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George B. Vaughan

Training & Development (MEd)

Degree Requirements

Code	Title	Hours	Counts towards
EAC 556	Organization Change in HRD: Theory & Practice	3	
EAC 559	The Adult Learner	3	
EAC 580	Designing Instructional Systems in Training and Development	3	
EAC 581	Advanced Instructional Design in Training and Development	3	
EAC 582	Organization and Operation Of Training and Development Programs	3	
EAC 583	Needs Assessment and Task Analysis in Training and Development	3	
EAC 584	Evaluating Training Transfer and Effectiveness	3	
EAC 585	Integrating Technology into Training Program	3	
EAC 586	Methods and Techniques Of Training and Development	3	
Select three credits of EAC electives [1]		3	
EAC 551	Research in Adult & Higher Education	3	
EAC 692	Research Projects In Education	3	
Total Hours		**36**	

[1] Any EAC course not part of of core curriculum (A)

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Training & Development (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Graduate Certificates - College of Education

Certificates

- Counselor Education (Certificate) (p. 307)
- Learning Analytics (Certificate) (p. 343)
- Mathematics Teaching and Learning (Certificate) (p. 337)
- Special Education (Certificate): Multi-Tiered System of Supports (MTSS) (p. 340)
- Teaching, Training, and Educational Technology (Certificate) (p. 316)

Counselor Education (Certificate)

Our innovative online program prepares school teachers, administrators, staff, advisors, tutors in schools and universities, human service workers, and individuals interested in counseling work to advocate and support students, their families, clients and local communities. Our certificate program allows students to learn in a flexible environment, with flexible online classwork, without the hassle of traffic and on-campus parking. Students will meet online each week for a 90-minute interactive discussion with the professor, instructors and classmates, in order to stay connected and challenged. The certificate program alone does not prepare students to work as professional counselors. In order to work in professional counseling, additional classes, training and licensure will be required through a master's degree program.

Admission Requirements

Applicants should have a 3.0 GPA but may be admitted provisionally based on related graduate classes completed in the field of education, human services or training and development, and, ultimately, by earning at least a "B" (3.0) average in the first GCCE class.

- Completed online Graduate School application and admission fee
- Resume outlining education and work experience

Applications are considered to begin the GCCE program in ***Summer II (Application Deadline of May 16 by 5 pm) or Fall (Application deadline of August 15 by 5 pm)***. These two main points serve as a great way to begin the GCCE program with registration for either Orientation to Professional Counseling, Identity, and Ethics (Summer II) or Multicultural Lifespan Development (Fall). If there are available seats throughout the rest of the academic year, it might be possible for a few students to begin the GCCE program during Summer I or Spring semesters.

Email us at ncsu_gcce@ncsu.edu with any questions.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**13**	
ECD 510	Orientation to Professional Counseling, Identity, and Ethics		
ECD 575	Multicultural Lifespan Development		
ECD 530	Theories and Tech of Counseling		
ECD 525	Multicultural Counseling		
Total Hours		**13**	

Mathematics Teaching and Learning (Certificate)

The Graduate Certificate in Mathematics Teaching and Learning is an online program that focuses on developing knowledge and instructional approaches in teaching mathematics. The program will primarily serve practicing teachers in middle school through college settings, or those preparing for careers in such settings, who want to expand their expertise related to teaching and learning mathematics. Students will learn how to apply research-based understandings of students' thinking, pedagogical approaches, and broader educational issues (e.g., discourse and equity) to inform practices of teaching content such as geometry, algebra, and statistics.

Plan Requirements

Code	Title	Hours	Counts towards
Select four of the following:		12	
EMS 510	Interactions In the Mathematics Classroom		
EMS 513	Teaching and Learning of Algebraic Thinking		
EMS 514	Teaching and Learning of Geometric Thinking		
EMS 519	Teaching and Learning of Statistical Thinking		
EMS 580	Teaching Mathematics with Technology		
Total Hours		**12**	

Teaching, Training, and Educational Technology (Certificate)

Delivered 100% online, the Certificate consists of five 3-credit courses focused on teaching, training, and the use of technology in a variety of educational environments. Students can tailor the program to meet their needs and gain the knowledge and skills necessary to design and deliver course-related content through face-to-face, technology-enhanced, and e-learning environments. The program is designed for mid-career individuals who may be without academic preparation for their current positions, or for those choosing to increase their knowledge and skills in the field for future job opportunities.

Students may choose one of the following specialty areas:

- Training and Development,
- Instructional Design,
- E-Learning,
- Community College Teaching,
- and Community College Leadership.

In order to be awarded the Certificate, all required courses must be taken and one elective is allowed. Transfer credit from other institutions is not allowed.

Plan Requirements

Students can choose courses from the following specializations:

- Talent Development (p. 316)
- Instructional Design (p. 316)
- E-Learning / Educational Technology (p. 317)
- Community College Teaching (p. 317)
- Community College Leadership (p. 317)

Certificates earned will be distributed as: "Graduate Certificate in Teaching, Training, and Educational Technology" without focus area specifications.

Talent Development

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 559	The Adult Learner	3	

EAC 582	Organization and Operation Of Training and Development Programs	3
EAC 586	Methods and Techniques Of Training and Development	3
Select one of the following electives:		3
EAC 556	Organization Change in HRD: Theory & Practice	
EAC 580	Designing Instructional Systems in Training and Development	
EAC 584	Evaluating Training Transfer and Effectiveness	
Total Hours		**15**

Instructional Design

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 580	Designing Instructional Systems in Training and Development	3	
EAC 581	Advanced Instructional Design in Training and Development	3	
EAC 583	Needs Assessment and Task Analysis in Training and Development	3	
Select one of the following electives:		3	
EAC 559	The Adult Learner		
EAC 584	Evaluating Training Transfer and Effectiveness		
EAC 585	Integrating Technology into Training Program		
Total Hours		**15**	

E-Learning / Educational Technology

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 539	Teaching in the Online Environment	3	
EAC 580	Designing Instructional Systems in Training and Development	3	
EAC 585	Integrating Technology into Training Program	3	
Select one of the following electives:		3	
EAC 581	Advanced Instructional Design in Training and Development		
EAC 583	Needs Assessment and Task Analysis in Training and Development		
EAC 560/584	Assessment & Evaluation in Adult & Higher Education		
Total Hours		**15**	

Community College Teaching

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 538	Instructional Strategies In Adult and Higher Education	3	
EAC 559	The Adult Learner	3	
EAC 560	Assessment & Evaluation in Adult & Higher Education	3	
EAC 539	Teaching in the Online Environment	3	

or EAC 700	Community College and Two-Year Postsecondary Education	
Total Hours		**15**

Community College Leadership

Code	Title	Hours	Counts towards
Required Courses			
EAC 692	Research Projects In Education	3	
EAC 595	Special Topics (Leadership)	3	
EAC 700	Community College and Two-Year Postsecondary Education	3	
EAC 704	Leadership In Higher and Community College Education	3	
Select one of the following:		3	
EAC 559	The Adult Learner		
EAC 703	The Programming Process In Adult and Community College Education		
EAC 795	Topical Problems in Adult and Community College Education (Contemporary Issues in Adult and Community College Education)		
EAC 778	Law and Higher Education		
Total Hours		**15**	

College of Engineering

Programs

- Aerospace Engineering (p. 374)
- Biomanufacturing (p. 380)
- Biomedical Engineering (p. 387)
- Chemical Engineering (p. 392)
- Civil Engineering (p. 401)
- Computer Engineering (p. 425)
- Computer Networking (p. 437)
- Computer Science (p. 443)
- Electric Power System Engineering (p. 459)
- Electrical Engineering (p. 463)
- Engineering (p. 483)
- Engineering Management (p. 492)
- Environmental Engineering (p. 502)
- Industrial Engineering (p. 518)
- Integrated Manufacturing Systems Engineering (p. 526)
- Materials Science & Engineering (p. 532)
- Mechanical Engineering (p. 543)
- Nanoengineering (p. 549)
- Nuclear Engineering (p. 554)

Degree Programs

Master's (MR)

- Biomanufacturing (MR) (p. 380)
- Chemical Engineering (MR) (p. 393)
- Civil Engineering (MR) (p. 403)
- Computer Science (MR) (p. 445)
- Engineering (MR) (p. 484)
- Engineering (MR): Aerospace Engineering Concentration (p. 484)
- Engineering (MR): Chemical Engineering Concentration (p. 485)
- Engineering (MR): Computer Engineering Concentration (p. 486)
- Engineering (MR): Computer Science Concentration (p. 487)
- Engineering (MR): Engineering Management Concentration (p. 488)
- Engineering (MR): Industrial Engineering Concentration (p. 489)
- Engineering (MR): Materials Science and Engineering Concentration (p. 489)
- Engineering (MR): Mechanical Engineering Concentration (p. 490)
- Engineering (MR): Nuclear Engineering Concentration (p. 491)
- Engineering Management (MR) (p. 492)
- Engineering Management (MR): Analytics Concentration (p. 493)
- Engineering Management (MR): Entrepreneurship Concentration (p. 494)
- Engineering Management (MR): Facilities Engineering Concentration (p. 495)
- Engineering Management (MR): General Concentration (p. 497)
- Engineering Management (MR): Health and Human Systems Concentration (p. 498)
- Engineering Management (MR): Professional Practice Concentration (p. 499)
- Engineering Management (MR): Supply Chain Engineering & Management Concentration (p. 500)
- Environmental Engineering (MR) (p. 503)
- Industrial Engineering (MR) (p. 519)
- Integrated Manufacturing Systems Engineering (MR) (p. 528)
- Materials Science and Engineering (MR) (p. 534)
- Nanoengineering (MR): Biomedical Sciences in Nanoengineering Concentration (p. 551)
- Nanoengineering (MR): Materials Science in Nanoengineering Concentration (p. 552)

- Nanoengineering (MR): Nanoelectronics and Nanophotonics Concentration (p. 553)
- Nuclear Engineering (MR) (p. 555)

Master of Science (MS)

- Aerospace Engineering (MS) (p. 376)
- Biomanufacturing (MS) (p. 382)
- Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration (p. 388)
- Chemical Engineering (MS) (p. 395)
- Civil Engineering (MS) (p. 412)
- Computer Engineering (MS) (p. 428)
- Computer Engineering (MS): Internship Concentration (p. 430)
- Computer Networking (MS) (p. 439)
- Computer Networking (MS): Internship Concentration (p. 441)
- Computer Science (MS) (p. 451)
- Electric Power Systems Engineering (MS) (p. 460)
- Electric Power Systems Engineering (MS): Internship Concentration (p. 461)
- Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration (p. 462)
- Electrical Engineering (MS) (p. 466)
- Electrical Engineering (MS): Internship Concentration (p. 468)
- Environmental Engineering (MS) (p. 513)
- Industrial Engineering (MS) (p. 521)
- Materials Science and Engineering (MS) (p. 536)
- Mechanical Engineering (MS) (p. 545)
- Nuclear Engineering (MS) (p. 556)

Doctor of Philosophy (PhD)

- Aerospace Engineering (PhD) (p. 377)
- Biomedical Engineering (PhD) (p. 390)
- Chemical Engineering (PhD) (p. 398)
- Civil Engineering (PhD) (p. 422)
- Computer Engineering (PhD) (p. 432)
- Computer Science (PhD) (p. 453)
- Electrical Engineering (PhD) (p. 471)
- Industrial Engineering (PhD) (p. 523)
- Materials Science and Engineering (PhD) (p. 537)
- Mechanical Engineering (PhD) (p. 546)
- Nuclear Engineering (PhD) (p. 558)

Minors

- Aerospace Engineering (Minor) (p. 378)
- Biomanufacturing (Minor) (p. 385)
- Biomedical Engineering (Minor) (p. 391)
- Chemical Engineering (Minor) (p. 400)
- Civil Engineering (Minor) (p. 423)
- Computer Engineering (Minor) (p. 434)
- Electrical Engineering (Minor) (p. 473)
- Industrial Engineering (Minor) (p. 525)
- Integrated Manufactoring Systems Engineering (Minor) (p. 531)
- Materials Science and Engineering (Minor) (p. 539)
- Mechanical Engineering (Minor) (p. 548)
- Nuclear Engineering (Minor) (p. 559)

Certificates

- 5G Technologies (Certificate) (p. 475)
- ASIC Design & Verification (Certificate) (p. 477)
- Computer Engineering (Certificate) (p. 435)
- Computer Science (Certificate) (p. 455)
- Cybersecurity (Certificate) (p. 227)
- Data Science Foundations (Certificate) (p. 457)
- Downstream Biomanufacturing (Certificate) (p. 386)
- Electrical Engineering (Certificate) (p. 479)
- Engineering Management Foundations (Certificate) (p. 501)
- Health Physics (Certificate) (p. 572)
- Materials Informatics (Certificate) (p. 540)
- Materials Science and Engineering (Certificate) (p. 540)
- Nano-Systems Engineering (Certificate) (p. 481)
- Nanobiotechnology (Certificate) (p. 392)
- Performance Based Earthquake Engineering (Certificate) (p. 425)
- Renewable Electric Energy Systems (Certificate) (p. 482)
- Upstream Biomanufacturing (Certificate) (p. 386)

Aerospace Engineering

Graduate students in the Aerospace Engineering program focus on aircraft and space systems design, analysis, and manufacturing. Students can select course offerings and research programs in aerodynamics and applied aerodynamics; aerospace propulsion; computational fluid dynamics; dynamics and design of spacecraft and space systems; flight dynamics and control; and multifunctional materials and smart structures. Sub-areas include acoustics, sprays, composite materials, reactive and multiphase flows, stability, and transition to turbulence.

Admission Requirements

An applicant to the master's program must be a graduate of an accredited undergraduate program with a B.S. degree in either mechanical or aerospace engineering. Graduates of other accredited programs in engineering, physical sciences and mathematics may be considered but may be required to make up undergraduate deficiencies without graduate credit. Provisional admissions, as well as exceptions, are sometimes granted under special circumstances. The most qualified applicants are accepted first. Applicants to the Ph.D. program must have met the M.S. admission requirements and additionally must satisfy the Ph.D. admissions requirements. Applicants to the online, distance education M.S. program in mechanical or aerospace engineering are not required to take the GRE exam.

Master's Degree Requirements

The thesis-option M.S. degree program in aerospace engineering requires 21 hours of course credit and nine hours of thesis research. The non-thesis M.S. degree requires 27 hours of course credit and a three credit-hour project and is offered on campus as well as off campus, through distance education.

Ph.D. Degree Requirements

A minimum of 72 hours of credit are required to obtain the Ph.D. degree. A direct path to the Ph.D. from the B.S. is also available with which the student is granted the M.S. degree “enroute” to the Ph.D. The enroute Ph.D. (direct to Ph.D. path) requires a minimum of 3.5 undergraduate GPA.

Student Financial Support

Financial aid is offered to all admitted Ph.D. students.

Degrees

- Aerospace Engineering (MS) (p. 376)
- Aerospace Engineering (PhD) (p. 377)
- Aerospace Engineering (Minor) (p. 378)

Faculty

Full Professors

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He Huang

Jack Ray Edwards Jr.

Srinath Varadarajan Ekkad

Tiegang Fang

Ashok Gopalarathnam

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John S. Strenkowski

Aerospace Engineering (MS)

Master of Science Degree Requirements

Non-Thesis Option

Code	Title	Hours	Counts towards
Required Courses		**27**	
Select a minimum of nine 500-level to 700-level courses approved in conjunction with the academic committee *			
Project Course		**3**	
MAE 586	Project Work In Mechanical and Aerospace Engineering		
Total Hours		**30**	

Thesis Option

Code	Title	Hours	Counts towards
Required Courses		**21**	
Select a minimum of seven 500-level to 700-level courses approved in conjunction with the academic committee *			
Research Course		**9**	
MAE 695	Master's Thesis Research		
Total Hours		**30**	

* "Required Courses" may include up to three non-MAE courses approved by the Director of Graduate Programs

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Aerospace Engineering (PhD)

Degree Requirement

Code	Title	Hours	Counts towards
Required Courses		**39**	
Select a minimum of thirteen 500-level to 700-level courses [1]			
Minor Courses (Optional)		**9**	
"Minor Courses" are approved in conjunction with the academic committee [2]			
Research Courses		**24**	
MAE 895	Doctoral Dissertation Research		
Total Hours		**72**	

1 "Required Courses" must consist a minimum of two 700-level courses, and may consist of up to five non-MAE courses approved in conjunction with the academic committee.

2 "Minor Courses" are limited to 500-level and 700-level courses only

Additional Requirements

- Students with a previous MS degree from NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 30 credit hours
- Students with a previous MS from outside NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 18 credit hours

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Aerospace Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Biomanufacturing

The Golden LEAF Biomanufacturing Training and Education Center (BTEC) offers two graduate degrees: a thesis-based Master of Science (MS) in Biomanufacturing and a Master of Biomanufacturing (MR). Both are Professional Science Master's (PSM) degrees, which provide advanced education and training in a specific discipline while simultaneously developing business skills highly valued by employers.

Both degrees offer students the choice of upstream (fermentation) or downstream (purification) concentrations to accompany courses in global regulatory affairs, protein characterization techniques, case studies in cGMP manufacturing of influenza vaccine, case studies in monoclonal antibody production, advanced biomanufacturing and biocatalysis, and an industry internship. Both degrees also include professional skills training in effective oral, electronic, and written communications for both technical and business careers. All MBA courses are taught by faculty from the Jenkins Graduate School of Management, a part of NC State's Poole College of Management.

Admission Requirements

Admission to the BIOM program requires completion of an undergraduate degree in engineering, life science or physical sciences, letters of recommendation, and a statement of career goals. A minimum overall grade point average of 3.0 and GRE scores in the 80th percentile are also required. Applicants with previous industry experience or working professionals are strongly encouraged to apply.

Master’s Degree Requirements

Master of Biomanufacturing: BIOM students will complete a minimum of 36 total credit hours including a summer biomanufacturing industry internship, 3 credits of industry practicum case studies, 3 credits of global regulatory affairs and 9 credits of MBA courses in project management, biosciences management and business foundations.

Master of Science: The Master of Science degree requires a minimum of 36 credit hours. Similar to the MR, the BIOM Master of Science curriculum will combine interdisciplinary coursework with 6 MBA credits including a course in project management. In addition, the BIOM Master of Science program will provide more experience in bioprocess development research to familiarize students with the methods, ideals and goals of independent investigation, the concepts of quality by design (QbD), and methods used in industry for design of experiments (DoE) to define design space for industrial processes. As a consequence of the stronger focus on research, BIOM Master of Science students will complete 4 credit hours of industry-focused process research mentored by their BIOM graduate advisor. Each student will submit a written thesis, which will be presented to the student’s BIOM graduate advisory committee.

Student Financial Support

A limited number of full-time participants in the Master of Biomanufacturing program may be eligible for teaching assistantships or industry-sponsored graduate scholarships.

Other Relevant Information

BIOM accepts students in spring and fall semesters. A 10 credit hour graduate minor is also available for NCSU students currently enrolled in thesis-based graduate programs. Two unique 12 credit Graduate Certificates: Upstream Biomanufacturing and Downstream Biomanufacturing are also offered for students currently enrolled in other non-thesis graduate programs.

Degrees

- Biomanufacturing (MR) (p. 380)
- Biomanufacturing (MS) (p. 382)
- Biomanufacturing (Minor) (p. 385)
- Downstream Biomanufacturing (Certificate) (p. 386)
- Upstream Biomanufacturing (Certificate) (p. 386)

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Gavin John Williams

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Stefano Menegatti

Practice/Research/Teaching Professors

Kirill Efimenko

Gary Louis Gilleskie

Imara Yasmin Perera

John H. van Zanten

Emeritus Faculty

Michael Carl Flickinger

Biomanufacturing (MR)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Biomanufacturing" without focus area track specifications.

Code	Title	Hours	Counts towards
Core Courses		**18**	
BEC 575	Global Regulatory Affairs for Medical Products		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
BEC 590	Industry Practicum in Biomanufacturing (two semesters)		
BEC 601	Biomanufacturing Seminar (two semesters) *		
BEC 620	Leadership and Preparation for Industry Internship in Biomanufacturing		
ST 511	Statistical Methods For Researchers I		
BEC 515	Biopharmaceutica Product Characterization Techniques		
or BEC 588	Animal Cell Culture Engineering		
Focus Area Track		**6**	
Select courses from a category listed under "Focus Area Track Courses" below			
Professional Courses		**9**	
BUS 554	Project Management		
Select two of the following courses:			
MBA 585	Current Topics in BioSciences Management		
MBA 586	Legal, Regulatory and Ethical Issues in Life Science Industries		
MBA 590	Special Topics In Business Management		
BUS 501	Strategic Management Foundations		
COM 563	Public Relations Theory		
COM 598	Special Topics In Communication (Intro to Science Communication: Theory/Practice)		
Elective Courses		**3**	
Select three credit hours from "Elective Courses" listed below each focus area category			
Total Hours		**36**	

* BEC 601 is to be repeated twice to meet two total credit hours.

Focus Area Tracks

Upstream Track

Code	Title	Hours	Counts towards
CHE 563	Fermentation of Recombinant Microorganisms	2	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 580	cGMP Fermentation Operations	2	
Total Hours		**6**	

Elective Courses

Code	Title	Hours	Counts towards
Select three credits of the following courses:		**3**	
BEC 525	Molecular Biology for Biomanufacturing	2	
BEC 545	Cell Line Development for Biomanufacturing	2	
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 585	cGMP Downstream Operations	2	
BEC 583	Tissue Engineering Technologies	2	
BEC 595	Special Topics in Biomanufacturing	1-6	
BIT 501	Ethical Issues in Biotechnology	1	

BEC 669	Biomanufacturing Research Projects	1-4
BIT 510	Core Technologies in Molecular and Cellular Biology	4
BIT 566	Animal Cell Culture Techniques	2

Downstream Track

Code	Title	Hours	Counts towards
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 585	cGMP Downstream Operations	2	
Total Hours		**6**	

Elective Courses

Code	Title	Hours	Counts towards
Select three credits of the following courses:		**3**	
BEC 525	Molecular Biology for Biomanufacturing	2	
BEC 545	Cell Line Development for Biomanufacturing	2	
CHE 563	Fermentation of Recombinant Microorganisms	2	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 580	cGMP Fermentation Operations	2	
BEC 583	Tissue Engineering Technologies	2	
BEC 595	Special Topics in Biomanufacturing	1-6	
BIT 501	Ethical Issues in Biotechnology	1	
BEC 669	Biomanufacturing Research Projects	1-4	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 566	Animal Cell Culture Techniques	2	

Faculty

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Emeritus Faculty

Michael Carl Flickinger

Biomanufacturing (MS)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Biomanufacturing" without focus area track specifications.

Code	Title	Hours	Counts towards
Core Courses		**22**	
BEC 575	Global Regulatory Affairs for Medical Products		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
BEC 590	Industry Practicum in Biomanufacturing (two semesters)		
BEC 601	Biomanufacturing Seminar (two semesters) [1]		
BEC 620	Leadership and Preparation for Industry Internship in Biomanufacturing		
ST 511	Statistical Methods For Researchers I		
BEC 669	Biomanufacturing Research Projects [2]		
BEC 515	Biopharmaceutical Product Characterization Techniques		
or BEC 588	Animal Cell Culture Engineering		
Focus Area Track		**6**	
Select courses from a category listed under "Focus Area Track Courses" below			
Professional Courses		**6**	
BUS 554	Project Management		
Select one of the following courses:			
MBA 585	Current Topics in BioSciences Management		
MBA 586	Legal, Regulatory and Ethical Issues in Life Science Industries		
MBA 590	Special Topics In Business Management		
BUS 501	Strategic Management Foundations		
COM 563	Public Relations Theory		
COM 598	Special Topics In Communication (Intro to Science Communication: Theory/Practice)		
Elective Courses		**3**	
Select three credit hours from "Elective Courses" listed below each focus area category			
Total Hours		**37**	

1 BEC 601 must be repeated twice for a total of two credit hours.

2 BEC 669 must be repeated twice for a total of four credit hours.

Focus Area Tracks

Upstream Track

Code	Title	Hours	Counts towards
CHE 563	Fermentation of Recombinant Microorganisms	2	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 580	cGMP Fermentation Operations	2	
Total Hours		**6**	

Elective Courses

Code	Title	Hours	Counts towards
Select three credits of the following courses:		**3**	
BEC 525	Molecular Biology for Biomanufacturing	2	
BEC 545	Cell Line Development for Biomanufacturing	2	
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 585	cGMP Downstream Operations	2	
BEC 583	Tissue Engineering Technologies	2	
BEC 595	Special Topics in Biomanufacturing	1-6	
BIT 501	Ethical Issues in Biotechnology	1	

BEC 669	Biomanufacturing Research Projects	1-4
BIT 510	Core Technologies in Molecular and Cellular Biology	4
BIT 566	Animal Cell Culture Techniques	2

Downstream Track

Code	Title	Hours	Counts towards
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 585	cGMP Downstream Operations	2	
Total Hours		**6**	

Elective Courses

Code	Title	Hours	Counts towards
Select three credits of the following courses:		**3**	
BEC 525	Molecular Biology for Biomanufacturing	2	
BEC 545	Cell Line Development for Biomanufacturing	2	
CHE 563	Fermentation of Recombinant Microorganisms	2	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 580	cGMP Fermentation Operations	2	
BEC 583	Tissue Engineering Technologies	2	
BEC 595	Special Topics in Biomanufacturing	1-6	
BIT 501	Ethical Issues in Biotechnology	1	
BEC 669	Biomanufacturing Research Projects	1-4	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 566	Animal Cell Culture Techniques	2	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Biomanufacturing (Minor)

Plan Requirements

Master's Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
BEC 669	Biomanufacturing Research Projects		
Select a minimum of eight credit hours of courses listed under "Elective Courses" below			
Total Hours		**9**	

PhD Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
BEC 669	Biomanufacturing Research Projects		
Select a minimum of eight credit hours of courses listed under "Elective Courses" below			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
Select a minimum of eight of the following courses:		**8**	
BBS 526	Upstream Biomanufacturing Laboratory	2	
BEC 515	Biopharmaceutical Product Characterization Techniques	2	
BEC 525	Molecular Biology for Biomanufacturing	2	
BEC 532	Foundations of Downstream Processing and Formulation	2	
BEC 536	Introduction to Downstream Process Development	2	
BEC 545	Cell Line Development for Biomanufacturing	2	
BEC 575	Global Regulatory Affairs for Medical Products	3	
BEC 577	Advanced Biomanufacturing and Biocatalysis	3	
BEC 580	cGMP Fermentation Operations	2	
BEC 583	Tissue Engineering Technologies	2	
BEC 585	cGMP Downstream Operations	2	
BEC 588	Animal Cell Culture Engineering	2	
BEC 590	Industry Practicum in Biomanufacturing	3	
BEC 595	Special Topics in Biomanufacturing	1-6	
BIT 566	Animal Cell Culture Techniques	2	
CHE 563	Fermentation of Recombinant Microorganisms	2	
Total Hours		**42-47**	

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Downstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Downstream Biomanufacturing graduate certificates offer NC State graduate students and working professionals the opportunity for hands-on learning in BTEC's industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC's graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
BEC 532	Foundations of Downstream Processing and Formulation		
BEC 536	Introduction to Downstream Process Development		
BEC 585	cGMP Downstream Operations		
BEC 575	Global Regulatory Affairs for Medical Products		
Elective Course		**3**	
Select a minimum of three credits of the following:			
BEC 515	Biopharmaceutica Product Characterization Techniques		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
BEC 590	Industry Practicum in Biomanufacturing		
BUS 554	Project Management		
Total Hours		**12**	

Upstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Upstream Biomanufacturing graduate certificates offer NC State graduate students and working professionals the opportunity for hands-on learning in BTEC's industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC's graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
CHE 563	Fermentation of Recombinant Microorganisms		
BBS 526	Upstream Biomanufacturing Laboratory		
BEC 580	cGMP Fermentation Operations		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
Elective Course		**3**	
Select a minimum of three credits of the following:			
BEC 588	Animal Cell Culture Engineering		
BEC 575	Global Regulatory Affairs for Medical Products		
BEC 525	Molecular Biology for Biomanufacturing		

BEC 545	Cell Line Development for Biomanufacturing	
BIT 510	Core Technologies in Molecular and Cellular Biology	
BIT 566	Animal Cell Culture Techniques	
Total Hours		**12**

Biomedical Engineering

The Joint Biomedical Engineering Graduate Program is administered by the combined biomedical engineering graduate faculty from both North Carolina State University and University of North Carolina at Chapel Hill. The joint program also has close working relations with the Research Triangle Institute and industry within the Research Triangle area. These associations enable students to obtain research training in a wide variety of fields and facilitate the selection and performance of dissertation research. The department, thus, provides students with excellent opportunities to realize the goal of enhancing medical care through the application of modern technology.

Biomedical engineering is a dynamic field stressing the application of engineering techniques and mathematical analysis to biomedical problems. Faculty research programs are key to the program, and they include five primary research directions: rehabilitation engineering, regenerative medicine, biomedical imaging, microsystems engineering, and pharmacoengineering. The department offers graduate education in biomedical engineering leading to the master of science and doctor of philosophy degrees.

Students enter this program with backgrounds in engineering, physical science, mathematics or biological science. Curricula are tailored to fit the needs and develop the potential of individual students. In addition, courses in statistics, mathematics, life sciences and engineering sciences provide a well-rounded background of knowledge and skills.

Admission Requirements

Students must satisfy all entrance requirements for The Graduate School of the University of North Carolina at Chapel Hill or the Graduate School at North Carolina State University, and must demonstrate interest and capability commensurate with the quality of the biomedical engineering program. Prospective students may apply to the graduate school at either UNC–Chapel Hill or NC State. All applicants are considered together as a group. Generally, applications should be submitted by December 11 for consideration for admission in the coming fall semester. Applicants are expected to present Graduate Record Examination (GRE) scores; verbal scores should be at or above the 50th percentile and quantitative scores should be at or above the 70th percentile to be competitive. Admitted students are expected to have an average grade of B (cumulative GPA 3.30) or better and are encouraged to have undergraduate research experience. The program requires that a one-to-three page personal statement about research interest and background be submitted.

Students should have a good working knowledge of mathematics at least through differential equations, plus two years of physical or engineering science and basic courses in biological science. Deficiencies in preparation can be made up in the first year of graduate training

Doctoral Degree Requirements

A minimum of 52 semester hours of graduate work is required (beyond the Bachelor's degree). Degree candidates in this program are expected to obtain experience working in a research laboratory during their residence and to demonstrate proficiency in research. The Ph.D. dissertation should be judged by the graduate committee to be of publishable quality. The student must meet the Graduate School's residency requirement at UNC-CH or NC State as appropriate. Further information on the BME Ph.D. program can be found on the department website.

Required and highly recommended courses

Students are required to take a BME Seminar each semester which is offered at both UNC-CH and NC State. Students must also complete six credits of graduate engineering topics, six credits of graduate life science topics, three credits of engineering mathematics, and three credits of statistics. Students may choose from a number of courses to meet these requirements. Such choices are made in consultation with the student's academic advisor and the Director of Graduate Programs/Studies.

Comprehensive and Qualifying Examinations

Doctoral students qualify for the Ph.D. degree by meeting grade requirements in their core courses, and then advance on to written and oral preliminary exams before admission to candidacy. Details can be found on the department website.

Degrees

- Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration (p. 388)
- Biomedical Engineering (PhD) (p. 390)
- Biomedical Engineering (Minor) (p. 391)
- Nanobiotechnology (Certificate) (p. 392)

Faculty

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Ross Petrella

Anka Veleva

Biomedical Engineering (MS): Translation Innovation and Entrepreneurship Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**27**	
BME 501	Biomedical Innovation and Entrepreneurship I - Needs Discovery		
BME 502	Biomedical Innovation and Entrepreneurship II - Design and Regulation		
MBA 576	Technology Entrepreneurship and Commercializatior I		
BME 551	Medical Device Design		
BEC 575	Global Regulatory Affairs for Medical Products		
BME 503	Biomedical Innovation and Entrepreneurship III - Product Development		
MBA 577	Technology Entrepreneurship and Commercializatior II		

MBA 572	Venture Opportunity Analytics		

Code	Title	Hours	Counts towards
BME Technology Elective		**3**	
BME 525	Bioelectricity		
BME 540	Nanobiotechnology Processing, Characterization, and Applications		
BME 544	Orthopaedic Biomechanics		
BME 560	Medical Imaging: X-ray, CT, and Nuclear Medicine Systems		
BME 583	Tissue Engineering Technologies		
BME 584	Fundamentals of Tissue Engineering		
BME 790	Advanced Special Topics in Biomedical Engineering		
BME 590	Special Topics in Biomedical Engineering		
Total Hours		**30**	

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Biomedical Engineering (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
52 hour minimum		52	
BME 802	Advanced Seminar in Biomedical Engineering (each semester (except the semester prior to graduation))		
or BME 890	Doctoral Preliminary Examination		
Biology/Medicine: A two semester sequence covering core aspects of relevant biology and physiology			
Engineering: 6 hours			
Graduate-level mathematics: 3 hours			
Graduate-level statistics: 3 hours			
Scientific/Technical Electives: 9 hours minimum			
Dissertation Research: 6 hours minimum			
Total Hours		**52**	

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Biomedical Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Nanobiotechnology (Certificate)

With financial support from the North Carolina Biotechnology Center, UNC-Chapel Hill and NC State University offer graduate certificates in nanobiotechnology. Tremendous advances in development of nanoscale, nanostructured, and nano-enabled materials for biotechnology applications are currently taking place. In particular, the development of advanced materials (e.g., electronic materials, optical materials, biologically-derived materials, and nanoscale materials) will allow for the development of next generation systems for use in medicine, homeland defense, and agriculture. These systems will provide integration of multiple functions, miniaturization of devices, an increase in stability, and a decrease in cost. In order for universities, companies, and governmental agencies to pursue this highly specialized work, students must be trained at the graduate level to perform work at the interface of nanoscale science and biotechnology. The nanobiotechnology certificates are aligned with the need for highly trained professionals to nurture rapid growth of nanobiotechnology infrastructure in North Carolina. The keystone of the certificates at both universities is a core nanobiotechnology course (BME 540, 3 credit hours), in which lectures, open discussion, and student presentations will be used to introduce students to this area of study.

Plan Requirements

Code	Title	Hours	Counts towards
BME 540	Nanobiotechnology Processing, Characterization, and Applications	3	
Select nine hours of electives:		9	
BEC/CHE 562	Fundamentals of Bio-Nanotechnology (courses also offered at UNC-CH)		
CH 747	Nanobiotechnolog		
BIT 501	Ethical Issues in Biotechnology		
BME 566	Polymeric Biomaterials Engineering		
MSE 539	Advanced Materials		
Total Hours		**12**	

Chemical Engineering

Research activities in the department include: computational nanoscience and biology; biomolecular engineering and biotechnology; catalysis, combustion, kinetics and electrochemical engineering; biofuels and renewable energy technology; green chemistry and engineering; innovative textiles, polymers and colloids; nanoscience and nanoengineering; and thermodynamics and molecular simulation.

Admissions Requirements

Students admitted to the graduate program normally have a Bachelor's degree in chemical engineering or its equivalent. Students with undergraduate degrees in chemistry, physics or other engineering disciplines may be admitted but will be required to make up undergraduate course work deficiencies in chemical engineering without graduate credit. The most promising candidates will be accepted up to the number of spaces available.

Master of Science Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. A set of four core courses is required. Two options are provided. In the thesis option, the thesis must be defended in a final public oral examination. In the non-thesis option, the student must satisfactorily complete a total of 10 graduate courses. A unique feature of the non-thesis option is the availability of a Distance Education Masters in which the students can complete all 30 credit hours remotely through online courses offered via streaming videos without being on campus.

Master of Chemical Engineering Degree Requirements

The M.Ch.E. degree requires a minimum of 30 credit hours. A set of four core courses is required. A three-credit project is also required.

Doctor of Philosophy Degree Requirements

Students normally take a set of five core courses, two advanced courses and at least 6 credits of dissertation research. A thesis is required; this must be defended in a final public oral examination. In addition, the candidate must: (1) submit and defend an original written proposition in any area of chemical engineering, and (2) submit and defend a proposal to perform his/her thesis research.

Degrees

- Chemical Engineering (MR) (p. 393)
- Chemical Engineering (MS) (p. 395)
- Chemical Engineering (PhD) (p. 398)
- Chemical Engineering (Minor) (p. 400)

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Orlando J. Rojas

Martin Schoen

Sindee Lou Simon

Malgorzata Sliwinska-Bartowiak

Simeon D. Stoyanov

Chemical Engineering (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
CHE 711	Chemical Engineering Process Modeling		
CHE 713	Thermodynamics I		
CHE 715	Transport Phenomena		

CHE 717	Chemical Reaction Engineering	
Elective Courses		**18**
Select a minimum of six elective courses approved in conjunction with the academic committee		

CHE Courses

Code	Title	Hours	Counts towards
CHE 543	Polymer Science and Technology	3	
CHE 551	Biochemical Engineering	3	
CHE 560	Chemical Processing Of Electronic Materials	3	
CHE 562	Fundamentals of Bio-Nanotechnology	3	
CHE 563	Fermentation of Recombinant Microorganisms	2	
CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems	3	
CHE 577	Advanced Biomanufacturing and Biocatalysis	3	
CHE 596	Special Topics in Chemical Engineering (Core Chemical Engineering Concepts I (required of all non ChE majors; not available for others))	1-3	
CHE 596	Special Topics in Chemical Engineering (Core Chemical Engineering Concepts II (required of all non ChE majors; not available for others))	1-3	
CHE 596	Special Topics in Chemical Engineering (Colloid Science & Nanoscale Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Green Chemical Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Molecular Cell Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Chemical Process Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Polymer Rheology and Processing)	1-3	
CHE 596	Special Topics in Chemical Engineering (Drug Delivery Concepts)	1-3	
CHE 597	Chemical Engineering Projects	1-3	
CHE 761	Polymer Blends and Alloys	3	
CHE 775	Multi-Scale Modeling of Matter	3	
MA 501	Advanced Mathematics for Engineers and Scientists I	3	

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Orlando J. Rojas

Martin Schoen

Sindee Lou Simon

Malgorzata Sliwinska-Bartowiak

Simeon D. Stoyanov

Chemical Engineering (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Required Courses *		**12**	
CHE 711	Chemical Engineering Process Modeling		
CHE 713	Thermodynamics I		
CHE 715	Transport Phenomena		
CHE 717	Chemical Reaction Engineering		
Thesis Options			
Thesis			

CHE 695	Master's Thesis Research	
"Elective Courses" will be dextermined in conjunction with the academic committee to meet the 30 total hour requirement		
Non-Thesis		
"Elective Courses" will be dextermined in conjunction with the academic committee to meet the 30 total hour requirement		
Total Hours		**30**

* Non-CHE undergraduate majors are required to take CHE 596 Core Concepts I and CHE 596 Core Concepts II before they can take any 700-level courses.

CHE Courses

Code	Title	Hours	Counts towards
CHE 543	Polymer Science and Technology	3	
CHE 551	Biochemical Engineering	3	
CHE 560	Chemical Processing Of Electronic Materials	3	
CHE 562	Fundamentals of Bio-Nanotechnology	3	
CHE 563	Fermentation of Recombinant Microorganisms	2	
CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems	3	
CHE 577	Advanced Biomanufacturing and Biocatalysis	3	
CHE 596	Special Topics in Chemical Engineering (Core Chemical Engineering Concepts I (required of all non ChE majors; not available for others))	1-3	
CHE 596	Special Topics in Chemical Engineering (Core Chemical Engineering Concepts II (required of all non ChE majors; not available for others))	1-3	
CHE 596	Special Topics in Chemical Engineering (Colloid Science & Nanoscale Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Green Chemical Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Molecular Cell Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Chemical Process Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Polymer Rheology and Processing)	1-3	
CHE 596	Special Topics in Chemical Engineering (Drug Delivery Concepts)	1-3	
CHE 597	Chemical Engineering Projects	1-3	
CHE 711	Chemical Engineering Process Modeling	3	
CHE 713	Thermodynamics I	3	
CHE 715	Transport Phenomena	3	
CHE 717	Chemical Reaction Engineering	3	
CHE 761	Polymer Blends and Alloys	3	

CHE 775	Multi-Scale Modeling of Matter	3
MA 501	Advanced Mathematics for Engineers and Scientists I	3

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Full Professors

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Jan Genzer

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Hasan Jameel

Robert M. Kelly

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Simeon D. Stoyanov

Chemical Engineering (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**16**	
CHE 701	Introduction to Chemical Engineering Research		
CHE 702	Chemical Engineering Research Proposition		
CHE 711	Chemical Engineering Process Modeling		
CHE 713	Thermodynamics I		
CHE 715	Transport Phenomena		
CHE 717	Chemical Reaction Engineering		
Additional Courses		**6**	
Select six additional credit hours at 500 or 700 level in any technical discipline approved in conjunction with the academic committee			
Dissertation Research Course		**6**	
CHE 895	Doctoral Dissertation Research		
Elective Courses		**44**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 72 total credit hours			
Preliminary Exam			
The Preliminary Exam is taken in the 4th semester, however, it requires an annual progress report			
Total Hours		**72**	

Elective Courses

Code	Title	Hours	Counts towards
CHE 543	Polymer Science and Technology	3	
CHE 551	Biochemical Engineering	3	
CHE 560	Chemical Processing Of Electronic Materials	3	
CHE 562	Fundamentals of Bio-Nanotechnology	3	
CHE 563	Fermentation of Recombinant Microorganisms	2	
CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems	3	
CHE 577	Advanced Biomanufacturing and Biocatalysis	3	
CHE 596	Special Topics in Chemical Engineering (Colloid Science & Nanoscale Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Green Chemical Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Molecular Cell Engineering)	1-3	
CHE 596	Special Topics in Chemical Engineering (Chemical Process Engineering)	1-3	

CHE 596	Special Topics in Chemical Engineering (Polymer Rheology and Processing)	1-3
CHE 596	Special Topics in Chemical Engineering (Drug Delivery Concepts)	1-3
CHE 761	Polymer Blends and Alloys	3
CHE 775	Multi-Scale Modeling of Matter	3

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Simeon D. Stoyanov

Chemical Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Simeon D. Stoyanov

Civil Engineering

Graduate programs are offered in coastal and water resources engineering, computing and systems, construction engineering and management, environmental engineering, geotechnical and geoenvironmental engineering, mechanics and materials, structural engineering and mechanics, transportation engineering and materials.

Degrees earned will be distributed as: "Master of Civil Engineering", "Master of Science," and "Doctor of Civil Engineering" without specialization specifications.

Admission Requirements

Normal minimum GPA requirements include 3.0 overall and in the major. Students who do not meet these academic requirements may take graduate courses through the Non Degree Studies program to demonstrate academic ability, but consultation with the Director of Graduate Programs is strongly advised. Applicants without academic experience in civil engineering, construction engineering, or environmental engineering may be required to take undergraduate courses to remove deficiencies, but graduate credit is not given for these courses. The Graduate Record Examination is required for all international applicants and all applicants to the PhD, MSCE, or MSENE degree programs.

Master's Degree Requirements

Four Master's degrees, requiring a minimum of 30 or 31 credit hours, are available. At least two-thirds of a Master's program should be in a well-defined major area of concentration. The MCE is a non-thesis (Option B) degree with other requirements, such as independent projects or core courses, specified in some areas of specialization. A formal minor is not permitted. The MCE is available both on-campus and through distance education. The MSCE degree requires a thesis and a formal minor is optional. Requirements for the MENE and MSENE are the similar to those for the CE degrees.

Doctoral Degree Requirements

The Ph.D. typically requires one year of full-time course work beyond the master's degree and research culminating in a dissertation. The program must develop a well-defined major area of concentration and may include supporting courses outside the major or a formal minor in a related field. All specialty areas, including Environmental Engineering, are included in the one Ph.D. program.

Student Financial Support

Departmental teaching and research assistantships are available including coverage of tuition and health insurance. Fellowships -- full or supplemental to an assistantship -- are available for exceptional applicants. All financial aid recipients are selected on merit-based competition with other applicants. Applications requesting financial aid (both U.S. and international) should be submitted early: December 15 for Fall admission and by July 15 for Spring admission.

Degrees

- Civil Engineering (MR) (p. 403)
- Civil Engineering (MS) (p. 412)
- Civil Engineering (PhD) (p. 422)
- Civil Engineering (Minor) (p. 423)
- Performance Based Earthquake Engineering (Certificate) (p. 425)

Faculty

Full Professors

Sankarasubramanian Arumugam

Morton A. Barlaz

Joseph F. DeCarolis
Area of Research: Environmental and Energy Policy

John W. Baugh Jr.

Emily Zechman Berglund

Francis Lajara De Los Reyes III

Joel Ducoste

Henry C. Frey

Mohammed Awad Gabr

Murthy N.Guddati

Abhinav Gupta

Tasnim Hassan

Edward J. Jaselskis

Youngsoo R. Kim

Detlef R. Knappe

Mervyn J. Kowalsky

George F. List

Min Liu

Gnanamanikam Mahinthakumar

James M. Nau

Margery F. Overton

Ranji Ranjithan

William John Rasdorf

Rudolf Seracino

Akhtarhusein A. Tayebali

Billy Merle Williams Jr.

Associate Professors

Alex Albert
Area of Research: Construction Engineering and Management

Douglas F. Call
Area of Research: Environmental & Water Resources

Cassandra Alison Castorena

Joel Casey Dietrich

Andrew P. Grieshop

Jeremiah Johnson

Brina Mortensen Montoya

Daniel R. Obenour
Area of Research: Water Resources & Coastal Engineering

Mohammad Pour-Ghaz

Benjamin Shane Underwood

Assistant Professors

Katherine Anarde
Area of Research: Environmental, Water Resources, & Coastal Engineering

Tarek Aziz

Eleni Bardaka

Ashly Margot Cabas Mijares

Fernando Garcia Menendez

Ali Hajbabaie

Kook Han

Angela Rose Harris

Jordan Kern

Jason Fredrick Patrick

Giorgio Talotti Proestos

Andrew Joseph Ziccarelli

Practice/Research/Teaching Professors

Saran Srikanth Bodda

Florentino Banaag De La Cruz

Billy L. Edge

Meagan Kittle Autry

James William Levis

Gregory W. Lucier

Mohamad Shoaib Samandar

Elizabeth J. Sciaudone

Emeritus Faculty

William L. Bingham

Robert C. Borden

Roy H. Borden

Earl Downey Brill Jr

Allen C. Chao

John S. Fisher

Ajaya K. Gupta

Kerry S. Havner

Clinton L. Heimbach

Yasuyuki Horie

David West Johnston

Narendra P. Khosla

Michael Lloyd Leming

Vernon C. Matzen

Stephens W. Nunnally

M. Shamimur Rahman

Sami Rizkalla

Nagui M. Rouphail, *Distinguished Professor Emeritus*
Area of Research: Transportation Engineering & Systems

J. C. Smith

John R. Stone

Harvey E. Wahls

Paul Z. Zia

Adjunct Faculty

Amin Kamal Akhnoukh

Michael Scott Breen, *Adjunct Professor*
Area of Research: Environmental Engineering & Air Quality

Daniel J. Findley, *Adjunct Assistant Professor*
Area of Research: Transportation Research (ITRE)

Alejandra C. Geiger-Ortiz, *Adjunct Assistant Professor*
Area of Research: Coastal Engineering

Leta Huntsinger

Anderson Rodrigo de Queiroz, *Adjunct Research Assistant Professor*

Civil Engineering (MR)

Master of Civil Engineering Degree Requirements

Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

Computing & Systems Specialization

- Select at least 6 courses in the CE department

Code	Title	Hours	Counts towards
Core Courses			
Select a minimum of two courses of the following:		6	
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 591	Special Topics in Civil Engineering Computing		
CE 737	Computer-Aided Engineering Systems		
CE 791	Advanced Topics in Civil Engineering Computing (High performance computer modeling)		
CE 791	Advanced Topics in Civil Engineering Computing (Evolutionary computation)		
CE 791	Advanced Topics in Civil Engineering Computing (Inverse modeling)		
CE 791	Advanced Topics in Civil Engineering Computing (Advanced methods for systems analysis)		
CE 7XX	Complex adaptive systems analysis		
Electives [1]			
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 776	Advanced Water Management Systems	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Stochastic Methods)	3	
CE 724	Probabilistic Methods Of Structural Engineering	3	
CE 721	Matrix and Finite Element Structural Analysis	3	
Electives [2]			
ISE 501	Introduction to Operations Research	3	
MA/ISE 505	Linear Programming	3	
ISE 708	Integer Programming	3	
ISE 709	Dynamic Programming	3	
ISE 712	Bayesian Decision Analysis For Engineers and Managers	3	

MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 502	Advanced Mathematics for Engineers and Scientists II	3
MA/CSC 580		3
MA/CSC 583	Introduction to Parallel Computing	3
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA/ST 706	Nonlinear Programming	3
CSC 501	Operating Systems Principles	3
CSC 548	Parallel Systems	3
Total Hours		**63**

[1] Other relevant departmental courses

[2] Other recommended courses

Construction Engineering Specialization

Code	Title	Hours	Counts towards
Select a minimum of seven courses with CON prefix		21	
Select one non-CON prefix civil engineering course:		3	
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 592	Special Topics in Construction Engineering (Robotic Vision Systems)		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 528	Structural Design in Wood		
CE 548	Engineering Properties Of Soils I		
CE 549	Soil and Site Improvement		
CE 744	Foundation Engineering		
CE 503	Highway Design		
CE 504	Airport Planning and Design		
CE 755	Highway Pavement Design		
CE 590	Special Topics In Civil Engineering (Facilities Engineering)		
Select two of the following:		3	
CON XXX			
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 592	Special Topics in Construction Engineering (Robotic Vision Systems)		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		

CE 528	Structural Design in Wood	
CE 548	Engineering Properties Of Soils I	
CE 549	Soil and Site Improvement	
CE 744	Foundation Engineering	
CE 503	Highway Design	
CE 504	Airport Planning and Design	
CE 755	Highway Pavement Design	
CE 590	Special Topics In Civil Engineering (Facilities Engineering)	
ISE 501	Introduction to Operations Research	
ISE 510	Applied Engineering Economy	
ISE 562	Simulation Modeling	
ST 515	Experimental Statistics for Engineers I	
ST 516	Experimental Statistics For Engineers II	
EGR 590	Special Topics in Engineering (Environmental Compliance for Facilities Engineers)	
CE 675	Civil Engineering Projects (3 hours maximum)	3
Total Hours		**30**

Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
CE 607	Water Resource and Environmental Engineering Seminar	1	
Total Hours		**1**	

Geotechnical and Geoenvironmental Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
CE 675	Civil Engineering Projects (Independent Study)	3	
Total Hours		**3**	

Structural Engineering and Mechanics Specialization

Code	Title	Hours	Counts towards
Core Courses			
CE 515	Advanced Strength of Materials	3	
CE 526	Finite Element Method in Structural Engineering	3	
CE 527	Structural Dynamics	3	
Select one of the following SEM Behavior and Design courses:		3	
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 528	Structural Design in Wood		
CE 529	FRP Strengthening and Repair of Concrete Structures		
CE 726	Advanced Theory Of Concrete Structures		
CE 794	Advanced Topics in Structures and Mechanics		
Select two of the following additional SEM courses:		6	
CE 525	Advanced Structural Analysis		

CE 721	Matrix and Finite Element Structural Analysis	
CE 530	Properties of Concrete and Advanced Cement-Based Composites	
CE 714	Stress Waves	
CE 718	Constitutive Modeling of Engineering Materials	
CE 730	Mechanics and Failure of Quasi-Brittle Materials	
CE 723	Advanced Structural Dynamics	
CE 724	Probabilistic Methods Of Structural Engineering	
CE 725	Earthquake Structural Engineering	
CE 522	Theory and Design Of Prestressed Concrete	
CE 523	Theory and Behavior Of Steel Structures	
CE 524	Analysis and Design Of Masonry Structures	
CE 528	Structural Design in Wood	
CE 529	FRP Strengthening and Repair of Concrete Structures	
CE 726	Advanced Theory Of Concrete Structures	
CE 794	Advanced Topics in Structures and Mechanics	
Electives		
Total Hours		**18**

Electives

Code	Title	Hours	Counts towards
CE 525	Advanced Structural Analysis	3	
CE 721	Matrix and Finite Element Structural Analysis	3	
CE 530	Properties of Concrete and Advanced Cement-Based Composites	3	
CE 714	Stress Waves	3	
CE 718	Constitutive Modeling of Engineering Materials	3	
CE 730	Mechanics and Failure of Quasi-Brittle Materials	3	
CE 723	Advanced Structural Dynamics	3	
CE 724	Probabilistic Methods Of Structural Engineering	3	
CE 725	Earthquake Structural Engineering	3	
CE 522	Theory and Design Of Prestressed Concrete	3	
CE 523	Theory and Behavior Of Steel Structures	3	
CE 524	Analysis and Design Of Masonry Structures	3	
CE 528	Structural Design in Wood	3	
CE 529	FRP Strengthening and Repair of Concrete Structures	3	
CE 726	Advanced Theory Of Concrete Structures	3	
CE 794	Advanced Topics in Structures and Mechanics	1-3	

CE 537	Computer Methods and Applications	3
CE 591	Special Topics in Civil Engineering Computing	1-6
CE 737	Computer-Aided Engineering Systems	3
CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computing)	1-3
CE 548	Engineering Properties Of Soils I	3
CE 593	Special Topics in Geotechnical Engineering (Unsaturated Soil Mechanics)	3
CE 593	Special Topics in Geotechnical Engineering (Site Response Analysis)	3
CE 741	Geomechanics of Stress Deformation	3
CE 742	Deformation and Instability of Soils	3
CE 744	Foundation Engineering	3
CE 746	Soil Dynamics and Earthquake Engineering	3
CE 747	Geosynthetics in Geotechnical Engineering	3
CE 596	Special Topics in Water Resource and Environmental Engineering (Engineering Measurement and Data Analysis)	3
CE 594	Special Topics in Structures and Mechanics (Nondestructive Evaluation of Civil Infrastructure)	3
CE 759	Inelastic Behavior Of Construction Materials	3
MA 405	Introduction to Linear Algebra	3
MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 502	Advanced Mathematics for Engineers and Scientists II	3
CE 675	Civil Engineering Projects (Independent Study)	1-3

Transportation Materials and Systems Specialization

- 30-31 graduate credit hours
- 24/30 credits at 500-level or higher

Code	Title	Hours	Counts towards
Related Courses			
CE 501	Transportation Systems Engineering	3	
CE 502	Traffic Operations	3	
CE 503	Highway Design	3	
CE 504	Airport Planning and Design	3	
CE 506	Transportation Engineering Data Collection and Analysis	3	
CE 509	Highway Safety	3	
CE 594	Special Topics in Structures and Mechanics (Nondestructive Testing)	1-6	
CE 595	Special Topics in Transportation Engineering (Asphalt/ Bituminous Materials)	1-6	
CE 595	Special Topics in Transportation Engineering (Sensors and Instrumentation)	1-6	

CE 595	Special Topics in Transportation Engineering (Railroad Engineering)	1-6
CE 595	Special Topics in Transportation Engineering (Unconventional Intersection and Interchange Design)	1-6
CE 701	Urban Transportation Planning	3
CE 702	Traffic Flow Theory	3
CE 705	Intelligent Transportation Systems	3
CE 706	Advanced Traffic Control	3
CE 707	Transportation Policy and Funding	3
CE 755	Highway Pavement Design	3
CE 757	Pavement Management Systems	3
CE 759	Inelastic Behavior Of Construction Materials	3
CE 795	Advanced Topics in Transportation Engineering (Transportation Economics)	1-3
CE 795	Advanced Topics in Transportation Engineering (Transportation Logistics)	1-3

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

CCEE Department ABM Admission

The CCEE department encourages excellent undergraduate students to obtain a master's degree in their chosen field of specialization within 2 to 3 semesters past BS graduation, through double counting up to 9 credit hours towards both bachelor's and master's degrees. This is referred to as the Accelerated Bachelor's/Master's (ABM) degree program. Following is the pathway for the ABM program.

Step 1 – Verify your eligibility for applying to the ABM program

- You must have completed at least 75 credit hours (this typically means junior standing)
  - If you are a transfer student, you must have completed at least two semesters at NCSU, earning a minimum of 24 credit hours
- You must not have already received a BS degree
- You must have an overall GPA # 3.5 and major GPA # 3.25

Step 2 – Apply for ABM by following the steps below

- Determine your area of interest from the list of graduate specialty areas on the next page.
- Talk to the ABM advisor in the specialty area (provided below), and agree on a tentative ABM Plan of Work (POW) that would suit your interests and satisfy the ABM requirements. A finalized ABM POW must be in place before completion of the BS degree.
- Submit an application at go.ncsu.edu/ccee-abm (https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56), which includes the tentative ABM POW.
  - The application will first be reviewed by the ABM advisor and a recommendation will be made to the department. The final determination will be made after a joint review by the directors of undergraduate and graduate programs, after which you will be notified.

Step 3 – While in the ABM program, maintain status by following the steps below:

- With the specialty area ABM advisor's help, prepare a tentative Graduate POW, that complements the Undergraduate POW.
  - Up to 9 credit hours can be double counted, they must be at the 500 level, and they must be selected from the approved list of courses in the specialty area (provided in the subsequent pages).
  - The (tentative) Graduate POW must be formally approved by the ABM advisor.
- It is your responsibility to ensure that both the Graduate POW and Undergraduate POW satisfy the respective master's and undergraduate degree requirements
- You must maintain an overall GPA # 3.5 and a major GPA # 3.25 until you enter the master's program.
- Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master's degree.
- Towards the end of your bachelor's program, you must formally apply to the master's program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a

completed and signed ABM Plan of Work (https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf).

- You must complete the master's degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master's student needing to take the full 30/31 graduate credits solely towards your master's degree.

Graduate Specialty Areas for ABM

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

Allowable Courses by Specialty Area

Computing Systems

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 590	Special Topics In Civil Engineering (Civil Engineering Systems)		

Construction Engineering

Code	Title	Hours	Counts towards
CE 561	Construction Project Management		
CE 562	Lean Construction Concepts and Methods		
CE 564	Legal Aspects of Contracting		
CE 565	Construction Safety Management		
CE 567	Risk and Financial Management in Construction		
CE 592	Special Topics in Construction Engineering		

Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:

CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 548	Engineering Properties Of Soils I		

EWC – Air

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control *		
CE 578	Energy and Climate *		
CE 579	Principles of Air Quality Engineering *		

EWC – Environmental Process eNGINEERING

Code	Title	Hours	Counts towards
CE 571	Physical Principles of Environmental Engineering		
CE 573	Biological Principles of Environmental Engineering		
CE 574	Chemical Principles of Environmental Engineering		

CE 577	Engineering Principles Of Solid Waste Management *		
CE 578	Energy and Climate *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Global Sanitation) *		

EWC – Water Resources, Coastal

Code	Title	Hours	Counts towards
CE 581	Fluid Mechanics in Natural Environments		
CE 583	Engineering Aspects Of Coastal Processes		
CE 584	Hydraulics Of Ground Water		
CE 586	Engineering Hydrology		
CE 588	Water Resources Engineering *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)		
CE 596	Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)		

Geotechnical Engineering

Code	Title	Hours	Counts towards
CE 548	Engineering Properties Of Soils I		
CE 584	Hydraulics Of Ground Water		
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 526	Finite Element Method in Structural Engineering		
CE 577	Engineering Principles Of Solid Waste Management		

Structural Engineering and Mechanics

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 525	Advanced Structural Analysis		
CE 526	Finite Element Method in Structural Engineering		
CE 527	Structural Dynamics		
CE 528	Structural Design in Wood		
CE 529	FRP Strengthening and Repair of Concrete Structures		

CE 530	Properties of Concrete and Advanced Cement-Based Composites		

Transportation Materials

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 530	Properties of Concrete and Advanced Cement-Based Composites		
CE 548	Engineering Properties Of Soils I		
CE 595	Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)		

Transportation Systems

Code	Title	Hours	Counts towards
CE 501	Transportation Systems Engineering *		
CE 502	Traffic Operations *		
CE 503	Highway Design *		
CE 504	Airport Planning and Design		
CE 505	Railroad System Planning, Design, and Operation		
CE 509	Highway Safety		

* This course is not a prerequisite but recommended to be completed prior to enrollment.

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Area of Research: Environmental Engineering & Air Quality

Daniel J. Findley, *Adjunct Assistant Professor*
Area of Research: Transportation Research (ITRE)

Alejandra C. Geiger-Ortiz, *Adjunct Assistant Professor*
Area of Research: Coastal Engineering

Leta Huntsinger

Anderson Rodrigo de Queiroz, *Adjunct Research Assistant Professor*

Civil Engineering (MS)

Master of Science Degree Requirements

Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science" without specialization specifications.

Computing & Systems Specialization

- Select at least five courses in the CE department

Code	Title	Hours	Counts towards
Core Courses			
Select a minimum of two courses of the following:		6	

CE 536	Introduction to Numerical Methods for Civil Engineers	
CE 537	Computer Methods and Applications	
CE 591	Special Topics in Civil Engineering Computing	
CE 737	Computer-Aided Engineering Systems	
CE 791	Advanced Topics in Civil Engineering Computing (High performance computer modeling)	
CE 791	Advanced Topics in Civil Engineering Computing (Evolutionary computation)	
CE 791	Advanced Topics in Civil Engineering Computing (Inverse modeling)	
CE 791	Advanced Topics in Civil Engineering Computing (Advanced methods for systems analysis)	
CE 7XX	Complex adaptive systems analysis	
Electives [1]		
CE 775	Modeling and Analysis Of Environmental Systems	3
CE 776	Advanced Water Management Systems	3
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Stochastic Methods)	3
CE 724	Probabilistic Methods Of Structural Engineering	3
CE 721	Matrix and Finite Element Structural Analysis	3
Electives [2]		
ISE 501	Introduction to Operations Research	3
MA/ISE 505	Linear Programming	3
ISE 708	Integer Programming	3
ISE 709	Dynamic Programming	3
ISE 712	Bayesian Decision Analysis For Engineers and Managers	3
MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 502	Advanced Mathematics for Engineers and Scientists II	3
MA/CSC 580		3
MA/CSC 583	Introduction to Parallel Computing	3
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA/ST 706	Nonlinear Programming	3
CSC 501	Operating Systems Principles	3
CSC 548	Parallel Systems	3
Thesis Research		
CE 695	Master's Thesis Research	3-6
Total Hours		**66-69**

[1] Other relevant departmental courses

[2] Other recommended courses

Construction Engineering Specialization

Code	Title	Hours	Counts towards
Select a minimum of seven courses CON XXX		21	
Select one of the following:		3	
CON XXX			
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 592	Special Topics in Construction Engineering		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 528	Structural Design in Wood		
CE 548	Engineering Properties Of Soils I		
CE 549	Soil and Site Improvement		
CE 744	Foundation Engineering		
CE 503	Highway Design		
CE 504	Airport Planning and Design		
CE 755	Highway Pavement Design		
CE 590	Special Topics In Civil Engineering		
ISE 501	Introduction to Operations Research		
ISE 510	Applied Engineering Economy		
ISE 562	Simulation Modeling		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
EGR 590	Special Topics in Engineering		
CE 675	Civil Engineering Projects (3 hours maximum)	3	
CE 695	Master's Thesis Research	6	
Total Hours		**33**	

Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
CE 607	Water Resource and Environmental Engineering Seminar	1	
CE 695	Master's Thesis Research	1-6	
Total Hours		**2-7**	

Geotechnical and Geoenvironmental Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
CE 695	Master's Thesis Research	6	
Total Hours		**6**	

Mechanics and Materials Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
CE 695	Master's Thesis Research	1-6	
Total Hours		**1-6**	

Structural Engineering and Mechanics Specialization

Code	Title	Hours	Counts towards
Core Courses			
CE 515	Advanced Strength of Materials	3	

CE 526	Finite Element Method in Structural Engineering	3
CE 527	Structural Dynamics	3
Select one of the following SEM Behavior and Design courses:		3
CE 522	Theory and Design Of Prestressed Concrete	
CE 523	Theory and Behavior Of Steel Structures	
CE 524	Analysis and Design Of Masonry Structures	
CE 528	Structural Design in Wood	
CE 529	FRP Strengthening and Repair of Concrete Structures	
CE 726	Advanced Theory Of Concrete Structures	
CE 794	Advanced Topics in Structures and Mechanics	
Select two of the following additional SEM courses:		6
CE 525	Advanced Structural Analysis	
CE 721	Matrix and Finite Element Structural Analysis	
CE 530	Properties of Concrete and Advanced Cement-Based Composites	
CE 714	Stress Waves	
CE 718	Constitutive Modeling of Engineering Materials	
CE 730	Mechanics and Failure of Quasi-Brittle Materials	
CE 723	Advanced Structural Dynamics	
CE 724	Probabilistic Methods Of Structural Engineering	
CE 725	Earthquake Structural Engineering	
CE 522	Theory and Design Of Prestressed Concrete	
CE 523	Theory and Behavior Of Steel Structures	
CE 524	Analysis and Design Of Masonry Structures	
CE 528	Structural Design in Wood	
CE 529	FRP Strengthening and Repair of Concrete Structures	
CE 726	Advanced Theory Of Concrete Structures	
CE 794	Advanced Topics in Structures and Mechanics	
Electives		
CE 695	Master's Thesis Research	1-6
Total Hours		**19-24**

Electives

Code	Title	Hours	Counts towards
CE 525	Advanced Structural Analysis	3	
CE 721	Matrix and Finite Element Structural Analysis	3	
CE 530	Properties of Concrete and Advanced Cement-Based Composites	3	
CE 714	Stress Waves	3	
CE 718	Constitutive Modeling of Engineering Materials	3	
CE 730	Mechanics and Failure of Quasi-Brittle Materials	3	

CE 723	Advanced Structural Dynamics	3
CE 724	Probabilistic Methods Of Structural Engineering	3
CE 725	Earthquake Structural Engineering	3
CE 522	Theory and Design Of Prestressed Concrete	3
CE 523	Theory and Behavior Of Steel Structures	3
CE 524	Analysis and Design Of Masonry Structures	3
CE 528	Structural Design in Wood	3
CE 529	FRP Strengthening and Repair of Concrete Structures	3
CE 726	Advanced Theory Of Concrete Structures	3
CE 794	Advanced Topics in Structures and Mechanics	1-3
CE 537	Computer Methods and Applications	3
CE 591	Special Topics in Civil Engineering Computing	1-6
CE 737	Computer-Aided Engineering Systems	3
CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computing)	1-3
CE 548	Engineering Properties Of Soils I	3
CE 593	Special Topics in Geotechnical Engineering (Unsaturated Soil Mechanics)	3
CE 593	Special Topics in Geotechnical Engineering (Site Response Analysis)	3
CE 741	Geomechanics of Stress Deformation	3
CE 742	Deformation and Instability of Soils	3
CE 744	Foundation Engineering	3
CE 746	Soil Dynamics and Earthquake Engineering	3
CE 747	Geosynthetics in Geotechnical Engineering	3
CE 596	Special Topics in Water Resource and Environmental Engineering (Engineering Measurement and Data Analysis)	3
CE 594	Special Topics in Structures and Mechanics (Nondestructive Evaluation of Civil Infrastructure)	3
CE 759	Inelastic Behavior Of Construction Materials	3
MA 405	Introduction to Linear Algebra	3
MA 501	Advanced Mathematics for Engineers and Scientists I	3
MA 502	Advanced Mathematics for Engineers and Scientists II	3
CE 675	Civil Engineering Projects (Independent Study)	1-3

Transportation Materials and Systems Specialization

- 30-31 graduate credit hours
- 24/30 credits at 500-level or higher

Code	Title	Hours	Counts towards
Related Courses			
CE 501	Transportation Systems Engineering	3	
CE 502	Traffic Operations	3	
CE 503	Highway Design	3	
CE 504	Airport Planning and Design	3	
CE 506	Transportation Engineering Data Collection and Analysis	3	
CE 509	Highway Safety	3	
CE 594	Special Topics in Structures and Mechanics (Nondestructive Testing)	1-6	
CE 595	Special Topics in Transportation Engineering (Asphalt/ Bituminous Materials)	1-6	
CE 595	Special Topics in Transportation Engineering (Sensors and Instrumentation)	1-6	
CE 595	Special Topics in Transportation Engineering (Railroad Engineering)	1-6	
CE 595	Special Topics in Transportation Engineering (Unconventional Intersection and Interchange Design)	1-6	
CE 701	Urban Transportation Planning	3	
CE 702	Traffic Flow Theory	3	
CE 705	Intelligent Transportation Systems	3	
CE 706	Advanced Traffic Control	3	
CE 707	Transportation Policy and Funding	3	
CE 755	Highway Pavement Design	3	
CE 757	Pavement Management Systems	3	
CE 759	Inelastic Behavior Of Construction Materials	3	
CE 795	Advanced Topics in Transportation Engineering (Transportation Economics)	1-3	
CE 795	Advanced Topics in Transportation Engineering (Transportation Logistics)	1-3	
Thesis Research			
Select up to six credit hours		1-6	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

CCEE Department ABM Admission

The CCEE department encourages excellent undergraduate students to obtain a master's degree in their chosen field of specialization within 2 to 3 semesters past BS graduation, through double counting up to 9 credit hours towards both bachelor's and master's degrees. This is referred to as the Accelerated Bachelor's/Master's (ABM) degree program. Following is the pathway for the ABM program.

Step 1 – Verify your eligibility for applying to the ABM program

- You must have completed at least 75 credit hours (this typically means junior standing)
  - If you are a transfer student, you must have completed at least two semesters at NCSU, earning a minimum of 24 credit hours
- You must not have already received a BS degree
- You must have an overall GPA # 3.5 and major GPA # 3.25

Step 2 – Apply for ABM by following the steps below

- Determine your area of interest from the list of graduate specialty areas on the next page.

- Talk to the ABM advisor in the specialty area (provided below), and agree on a tentative ABM Plan of Work (POW) that would suit your interests and satisfy the ABM requirements. A finalized ABM POW must be in place before completion of the BS degree.
- Submit an application at go.ncsu.edu/ccee-abm (https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56), which includes the tentative ABM POW.
  - The application will first be reviewed by the ABM advisor and a recommendation will be made to the department. The final determination will be made after a joint review by the directors of undergraduate and graduate programs, after which you will be notified.

Step 3 – While in the ABM program, maintain status by following the steps below:

- With the specialty area ABM advisor's help, prepare a tentative Graduate POW, that complements the Undergraduate POW.
  - Up to 9 credit hours can be double counted, they must be at the 500 level, and they must be selected from the approved list of courses in the specialty area (provided in the subsequent pages).
  - The (tentative) Graduate POW must be formally approved by the ABM advisor.
- It is your responsibility to ensure that both the Graduate POW and Undergraduate POW satisfy the respective master's and undergraduate degree requirements
- You must maintain an overall GPA # 3.5 and a major GPA # 3.25 until you enter the master's program.
- Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master's degree.
- Towards the end of your bachelor's program, you must formally apply to the master's program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a completed and signed ABM Plan of Work (https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf).
- You must complete the master's degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master's student needing to take the full 30/31 graduate credits solely towards your master's degree.

Graduate Specialty Areas for ABM

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

Allowable Courses by Specialty Area

COMPUTING SYSTEMS

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 590	Special Topics In Civil Engineering (Civil Engineering Systems)		

CONSTRUCTION ENGINEERING

Code	Title	Hours	Counts towards
CE 561	Construction Project Management		
CE 562	Lean Construction Concepts and Methods		
CE 564	Legal Aspects of Contracting		
CE 565	Construction Safety Management		
CE 567	Risk and Financial Management in Construction		
CE 592	Special Topics in Construction Engineering		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		

CE 548	Engineering Properties Of Soils I		

EWC – AIR

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control *		
CE 578	Energy and Climate *		
CE 579	Principles of Air Quality Engineering *		

EWC – ENVIRONMENTAL PROCESS ENGINEERING

Code	Title	Hours	Counts towards
CE 571	Physical Principles of Environmental Engineering		
CE 573	Biological Principles of Environmental Engineering		
CE 574	Chemical Principles of Environmental Engineering		
CE 577	Engineering Principles Of Solid Waste Management *		
CE 578	Energy and Climate *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Global Sanitation) *		

EWC – WATER RESOURCES, COASTAL

Code	Title	Hours	Counts towards
CE 581	Fluid Mechanics in Natural Environments		
CE 583	Engineering Aspects Of Coastal Processes		
CE 584	Hydraulics Of Ground Water		
CE 586	Engineering Hydrology		
CE 588	Water Resources Engineering *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)		
CE 596	Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)		

GEOTECHNICAL ENGINEERING

Code	Title	Hours	Counts towards
CE 548	Engineering Properties Of Soils I		
CE 584	Hydraulics Of Ground Water		
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 526	Finite Element Method in Structural Engineering		
CE 577	Engineering Principles Of Solid Waste Management		

STRUCTURAL ENGINEERING AND MECHANICS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		

CE 522	Theory and Design Of Prestressed Concrete
CE 523	Theory and Behavior Of Steel Structures
CE 524	Analysis and Design Of Masonry Structures
CE 525	Advanced Structural Analysis
CE 526	Finite Element Method in Structural Engineering
CE 527	Structural Dynamics
CE 528	Structural Design in Wood
CE 529	FRP Strengthening and Repair of Concrete Structures
CE 530	Properties of Concrete and Advanced Cement-Based Composites

TRANSPORTATION MATERIALS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 530	Properties of Concrete and Advanced Cement-Based Composites		
CE 548	Engineering Properties Of Soils I		
CE 595	Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)		

TRANSPORTATION SYSTEMS

Code	Title	Hours	Counts towards
CE 501	Transportation Systems Engineering *		
CE 502	Traffic Operations *		
CE 503	Highway Design *		
CE 504	Airport Planning and Design		
CE 505	Railroad System Planning, Design, and Operation		
CE 509	Highway Safety		

* This course is not a prerequisite but recommended to be completed prior to enrollment.

Faculty

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Area of Research: Transportation Research (ITRE)

Alejandra C. Geiger-Ortiz, *Adjunct Assistant Professor*
Area of Research: Coastal Engineering

Leta Huntsinger

Anderson Rodrigo de Queiroz, *Adjunct Research Assistant Professor*

Civil Engineering (PhD)

Degree Requirements

Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Civil Engineering" without specialization specifications.

- 54 graduate credit hours beyond master's
- Areas of Specialization
  - Computing and Systems
  - Construction Engineering
  - Environmental, Water Resources, and Coastal Engineering
  - Geotechnical/Geoenvironmental Engineering
  - Mechanics and Materials
  - Structural Engineering and Mechanics
  - Transportation Materials and Systems

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Fernando Garcia Menendez

Ali Hajbabaie

Kook Han

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Jordan Kern

Jason Fredrick Patrick

Giorgio Talotti Proestos

Andrew Joseph Ziccarelli

Practice/Research/Teaching Professors

Saran Srikanth Bodda

Florentino Banaag De La Cruz

Billy L. Edge

Meagan Kittle Autry

James William Levis

Gregory W. Lucier

Mohamad Shoaib Samandar

Elizabeth J. Sciaudone

Emeritus Faculty

William L. Bingham

Robert C. Borden

Roy H. Borden

Earl Downey Brill Jr

Allen C. Chao

John S. Fisher

Ajaya K. Gupta

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Stephens W. Nunnally

M. Shamimur Rahman

Sami Rizkalla

Nagui M. Rouphail, *Distinguished Professor Emeritus*
Area of Research: Transportation Engineering & Systems

J. C. Smith

John R. Stone

Harvey E. Wahls

Paul Z. Zia

Adjunct Faculty

Amin Kamal Akhnoukh

Michael Scott Breen, *Adjunct Professor*
Area of Research: Environmental Engineering & Air Quality

Daniel J. Findley, *Adjunct Assistant Professor*
Area of Research: Transportation Research (ITRE)

Alejandra C. Geiger-Ortiz, *Adjunct Assistant Professor*
Area of Research: Coastal Engineering

Leta Huntsinger

Anderson Rodrigo de Queiroz, *Adjunct Research Assistant Professor*

Civil Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Sankarasubramanian Arumugam

Morton A. Barlaz

Joseph F. DeCarolis
Area of Research: Environmental and Energy Policy

John W. Baugh Jr.

Emily Zechman Berglund

Francis Lajara De Los Reyes III

Joel Ducoste

Henry C. Frey

Mohammed Awad Gabr

Murthy N.Guddati

Abhinav Gupta

Tasnim Hassan

Edward J. Jaselskis

Youngsoo R. Kim

Detlef R. Knappe

Mervyn J. Kowalsky

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Min Liu

Gnanamanikam Mahinthakumar

James M. Nau

Margery F. Overton

Ranji Ranjithan

William John Rasdorf

Rudolf Seracino

Akhtarhusein A. Tayebali

Billy Merle Williams Jr.

Associate Professors

Alex Albert
Area of Research: Construction Engineering and Management

Douglas F. Call
Area of Research: Environmental & Water Resources

Cassandra Alison Castorena

Joel Casey Dietrich

Andrew P. Grieshop

Jeremiah Johnson

Brina Mortensen Montoya

Daniel R. Obenour
Area of Research: Water Resources & Coastal Engineering

Mohammad Pour-Ghaz

Benjamin Shane Underwood

Assistant Professors

Katherine Anarde
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Area of Research: Coastal Engineering

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Anderson Rodrigo de Queiroz, *Adjunct Research Assistant Professor*

Performance Based Earthquake Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
CE 527	Structural Dynamics		
CE 725	Earthquake Structural Engineering		
Elective Courses		**6**	
Select at least two of the following courses:			
CE 723	Advanced Structural Dynamics		
CE 727	Seismic Analysis, Assessment, and Design of Concrete Buildings		
CE 728	Performance Based Seismic Design of Bridges		
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)		
CE 746	Soil Dynamics and Earthquake Engineering		
Total Hours		**12**	

Computer Engineering

The Master of Science in Computer Engineering may be earned with thesis option or through the non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design.

Also a strong Ph.D. program is available for those who wish to pursue a research and/or teaching career in Industry, Government or Academia.

Admissions Requirements

Admission to the M.S. program requires a B.S. in electrical engineering, computer engineering or computer science, and an overall undergraduate GPA of at least 3.0. For non-native English speakers, the minimum acceptable TOEFL score for admission to the M.S. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but may be waived upon request for graduates from US Universities (see below). Admission is further limited by available room in the elected program of study. Meeting the above minimum requirements alone does not guarantee admission.

Applicants to the Master's and PhD programs who do not have a Bachelor's degree in Electrical Engineering or Computer Engineering, but have a closely related degree from an accredited college or university, must have taken the following pre-requisite courses: courses equivalent to ECE 109, ECE 209, ECE 212, ECE 220, ECE 301, ECE 302, ECE 309 and CSC 226.

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NC State may be waived. They also might be waived for graduates from US ABET accredited programs with good GPAs.

All international applicants from non English speaking countries must submit TOEFL scores. The TOEFL must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum of 18 on each section of the test with a minimum total of 90. Scores on previous versions of the TOEFL are considered with the same qualitative standard. On the IELTS, we require a minimum score of 6.5 in each section. This requirement also applies to US citizens

whose principal language of instruction has not been English (for example, most applicants from Puerto Rico and the Virgin Islands).

TOEFL - institution code 5496; department code 66
GRE - institution code 5496; department code 1203

Admission to the Ph.D. program requires a B.S. or M.S. in electrical engineering, computer engineering or computer science with an expectation of an overall GPA of at least 3.25. The minimum acceptable TOEFL score for admission to the Ph.D. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but might be waived for NC State graduates or graduates from other US ABET accredited schools with good GPAs. Admission is further limited by available room in the elected program of study, and meeting the minimum requirements as given above does not guarantee admission.

Master's Degree Requirements

Thirty-one (31) credit hours; a thesis is optional. Students must have at least 21 hours of ECE courses that cover at least three specialty areas and have at least three credit hours of advanced-level (700-level) ECE courses. Students electing the Option B non-thesis option must meet core course requirements; have ECE courses that cover at least three specialty areas' and have at least three credit hours of 700-level ECE courses.

The Master's degree is offered online through Engineering Online. Applications to these MS on-line programs are through the ECE Department and all students must comply with ECE program requirements.

Doctoral Degree Requirements

Approximately 54 credit hours are required beyond the M.S. degree or 72 credit hours beyond the B.S. degree. For those with an NC State MS degree in our department, no additional courses are required. For those with an NC State MS degree in another department, 6 credit hours are required in our department. For those with a non NC State MS degree, 12 credit hours of coursework are required. For those with only a Bachelors degree 30 credit hours of coursework are required. The remaining credit hours are research.

The department wishes to evaluate a Ph.D. student's research potential as quickly as possible. Consequently, all Ph.D. students are required to pass a qualifying review before the end of their third semester of study. This review is based on the student's academic performance to date and the results of a project with one of their committee members. Results are presented to the committee in both written and oral form. Based on this review, the committee will decide if the student may continue in the Ph.D. program.

Student Financial Support

The department offers financial support to qualified students in the form of teaching assistantships, research assistantships, and fellowships. These sources of support generally include coverage of tuition and fees.

Degrees

- Computer Engineering (MS) (p. 428)
- Computer Engineering (MS): Internship Concentration (p. 430)
- Computer Engineering (PhD) (p. 432)
- Computer Engineering (Minor) (p. 434)
- Computer Engineering (Certificate) (p. 435)

Faculty

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Mesut E. Baran

Salah M. A. Bedair

Subhashish Bhattacharya

Alper Yusuf Bozkurt

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Rada Yuryevna Chirkova

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Wesley E. Snyder

Computer Engineering (MS)

Master of Science Degree Requirements

Degrees earned will be distributed as: "Master of Science in Computer Engineering" without specialty or option specifications.

Code	Title	Hours	Counts towards
Required Courses		**1**	
ECE 600	ECE Graduate Orientation		
Core Courses [1]		**21**	
"Core Courses" are approved in conjunction with the academic committee			
Depth Courses	Select at least three credit hours of 700-level courses		
Major Courses	Select at least 15 credit hours of EE courses		
Breadth Course	Select at least three credit hours in different ECE specialites		
Additional Courses		**9**	
"Additional Courses" are approved in conjunction with the academic committee to meet 31 total hours			
Total Hours		**31**	

1 Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Computer Engineering (MS): Internship Concentration

This concentration will require an Internship of at least four months duration (maximum of seven months) and the student to take 3 credit hours of ECE 650 and obtain a Satisfactory grade. An internship of at least four calendar months duration would require that it span at least one semester and possibly part of summer. The credits for ECE 650 would be taken during the semester that includes the internship. The student would be considered as being enrolled full time during that semester.

Degree Requirements

A student would not enroll in this concentration in their first semester. They would switch to it in a later semester if they secure a suitable internship. Per normal CPT rules, International students studying on an F-1 visa would have to be present on a US campus for two full semesters (a full academic year), and present at NC State for one semester, before using CPT privileges to take an internship. If a student switches to this concentration but does not start the internship, they will switch back to the original plan.

This will be a concentration only for on-campus students. Students enrolled in our distance education – Engineering Online (EOL) - option will not be eligible.

Code	Title	Hours	Counts towards
Required Courses		**1**	
ECE 600	ECE Graduate Orientation		
Core Courses [1]		**21**	
"Core Courses" are approved in conjunction with the academic committee			
Depth Courses	Select at least three credit hours of 700-level courses		
Major Courses	Select at least 15 credit hours of EE courses		
Breadth Course	Select at least three credit hours in different ECE specialites		
Concentration Requirement		**3**	
ECE 650	Internship [2]		
Additional Courses		**6**	
"Additional Courses" are approved in conjunction with the academic committee to meet 31 total hours			
Total Hours		**31**	

[1] Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

[2] ECE 650 requires that a written report be submitted and accepted by an ECE faculty examiner as meeting the standards required by the course. The written report should cover both technical and non-technical aspects of what the student did and learned during the internship. The report should not disclose company proprietary information.

Faculty

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Computer Engineering (PhD)

Degree Requirements

Degrees earned will be distributed as: "Doctor of Philosophy Computer Engineering" without track specifications.

Code	Title	Hours	Counts towards
Required Courses		**72**	
ECE 600	ECE Graduate Orientation		
Select a minimum of two 700-level ECE courses			
Select a Master's Track			
ECE 833	Individual Topics In Electrical Engineering		
ECE 834	Individual Studies In Electrical Engineering		
ECE 895	Doctoral Dissertation Research		
Total Hours		**72**	

Master's Track

Code	Title	Hours	Counts towards
Non-NCSU Masters Requirements			
Select six credit hours		6	
Select six additional credit hours (ECE or other)		6	
Total Hours		**12**	

Code	Title	Hours	Counts towards
Requirements for Students w/out Master's Degree			
Select 18 ECE credit hours		18	
Select 12 additional credit hours (ECE or other)		12	
Total Hours		**30**	

Faculty

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Computer Engineering (Minor)

Plan Requirements

Master's Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select at least three 500- or 700-level courses approved in conjunction with the academic committee		
Total Hours		**9**	

PhD Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select at least four 500-level or above courses approved in conjunction with the academic committee		
Total Hours		**12**	

Faculty

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Computer Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four ECE courses at the 500- or 700-level *			
Total Hours		**12**	

* Courses are limited to Computer Engineering or cross-listed courses. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

Faculty

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Wilbur Carroll Peterson

Sarah Ann Rajala

Wesley E. Snyder

Computer Networking

The Master of Science in computer networking may be earned through the M.S. with thesis option or through the non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design environment, although students planning to continue on for a Ph.D. should discuss the option selected with their advisors.

The Master of Science in Computer Networking is also available as on online degree program. This degree has a non-thesis option, does not require on campus attendance, and may be used in preparation for further graduate student or employment in an industrial research, development or design environment. The program is available to USA residents and to United States military personnel serving overseas and it is offered online through Engineering Online.

Master's Degree Requirements

Computer networking core courses constitute 9 of the 30 minimum credit hours. Students take 12 additional credit hours of computer networking courses from one of four currently defined technical concentration areas: network design, network hardware, network software, or networking services. The remaining 9 credit hours may be taken from an approved management concentration sequence, as additional courses in the computer networking technical concentration areas, or as 6 hours of thesis and 3 credit hours from the list of approved computer networking courses. At least 6 of the 30 credits must come from the 700 level, and non-letter graded courses such as individual studies courses may account for a maximum of 3 credit hours.

Degrees

- Computer Networking (MS) (p. 439)
- Computer Networking (MS): Internship Concentration (p. 441)

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Wesley E. Snyder

Computer Networking (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
Select at least three courses from "Core Courses" listed below			
Theory Courses		**3**	
Select at least one courses from "Theory Courses" listed below			
Required Courses		**4**	
CSC 600	Computer Science Graduate Orientation		
or ECE 600	ECE Graduate Orientation		
Select at least one 700-level course			
Additional Courses		**15**	
"Additional Courses" are approved in conjunction with the academic committee			
Thesis Option Courses			
CSC 630	Master's Independent Study (Non-Thesis Option)		
or ECE 634	Individual Studies In Electrical Engineering		
CSC 695	Master's Thesis Research (Thesis Option)		
or ECE 695	Master's Thesis Research		
Total Hours		**31**	

Core Courses

Code	Title	Hours	Counts towards
Select at least three courses from the following:			
CSC/ECE 570	Computer Networks	3	
CSC/ECE 573	Internet Protocols	3	
CSC/ECE 574	Computer and Network Security	3	
CSC/ECE 575	Introduction to Wireless Networking	3	
CSC/ECE 577	Switched Network Management	3	

Theory Courses

Code	Title	Hours	Counts towards
Select a minimum of one course below:			
CSC 505	Design and Analysis Of Algorithms	3	
CSC 565	Graph Theory	3	
CSC/ECE 579	Introduction to Computer Performance Modeling	3	
CSC/ECE 776	Design and Performance Evaluation of Network Systems and Services	3	
ECE 766	Signal Processing for Communications & Networking	3	
CSC/ECE 777	Telecommunications Network Design	3	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

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Computer Networking (MS): Internship Concentration

Degree Requirements

This concentration will require an Internship of at least four months duration (maximum of seven months) and the student to take 3 credit hours of ECE 650 and obtain a Satisfactory grade. An internship of at least four calendar months duration would require that it span at least one semester and possibly part of summer. The credits for ECE 650 would be taken during the semester that includes the internship. The student would be considered as being enrolled full time during that semester.

A student would not enroll in this concentration in their first semester. They would switch to it in a later semester if they secure a suitable internship. Per normal CPT rules, International students studying on an F-1 visa would have to be present on a US campus for two full semesters (a full academic year), and present at NC State for one semester, before using CPT privileges to take an internship. If a student switches to this concentration but does not start the internship, they will switch back to the original plan.

This will be a concentration only for on-campus students. Students enrolled in our distance education – Engineering Online (EOL) - option will not be eligible.

Code	Title	Hours	Counts towards
Core Courses		**9**	
Select at least three courses from "Core Courses" listed below			
Theory Courses		**3**	
Select at least one courses from "Theory Courses" listed below			
Required Courses		**4**	
CSC 600	Computer Science Graduate Orientation		
or ECE 600	ECE Graduate Orientation		
Select at least one 700-level course			
Concentration Requirement		**3**	
ECE 650	Internship *		
Additional Courses		**12**	
"Additional Courses" are approved in conjunction with the academic committee			
Thesis Option Courses			
CSC 630	Master's Independent Study (Non-Thesis Option)		
or ECE 634	Individual Studies In Electrical Engineering		
CSC 695	Master's Thesis Research (Thesis Option)		
or ECE 695	Master's Thesis Research		
Total Hours		**31**	

* ECE 650 requires that a written report be submitted and accepted by an ECE faculty examiner as meeting the standards required by the course. The written report should cover both technical and non-technical aspects of what the student did and learned during the internship. The report should not disclose company proprietary information.

Core Courses

Code	Title	Hours	Counts towards
Select at least three courses from the following:			
CSC/ECE 570	Computer Networks	3	
CSC/ECE 573	Internet Protocols	3	
CSC/ECE 574	Computer and Network Security	3	
CSC/ECE 575	Introduction to Wireless Networking	3	
CSC/ECE 577	Switched Network Management	3	

Theory Courses

Code	Title	Hours	Counts towards
Select a minimum of one course below:			
CSC 505	Design and Analysis Of Algorithms	3	
CSC 565	Graph Theory	3	
CSC 579	Introduction to Computer Performance Modeling	3	
or ECE 579	Introduction to Computer Performance Modeling		
CSC/ECE 776	Design and Performance Evaluation of Network Systems and Services	3	
ECE 766	Signal Processing for Communications & Networking	3	
CSC/ECE 777	Telecommunications Network Design	3	

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Computer Science

The flagship degree is the Ph.D. in Computer Science, which prepares students for leadership positions in academia, industry research labs, and government. Alternatively, the master's degree program offers the Master of Science (thesis) and the Master of Computer Science (non-thesis, available via either distance learning or on-campus enrollment). There is also a Master of Computer Networking degree provided jointly through the Computer Science and the Electrical and Computer Engineering departments (see Computer Networking). Our graduate students also benefit from access to specialized career services. This includes the Corporate & Career Services suite, with opportunities for on-campus interviews, small group career workshops, virtual practice interviews, and individual career advising.

Admissions Requirements

Minimum application requirements include an accredited Bachelor's degree with at least a B average and, for non-Computer Science majors, strong academic performance in computer science and mathematics. Applicants must also submit the GRE General Test scores and international applicants must provide TOEFL or IELTS scores, as proof of English proficiency. We also ask for a Statement of Purpose to be included with the application as well as three professional or academic recommendations.

Those interested in developing their computer science knowledge and skills, but not ready to commit to a degree program, might consider one of our graduate certificates. Refer to the Graduate Certificate Programs listed in the selection under Computer Science.

Student Financial Support

Financial aid is offered to all admitted PhD students. Masters students are not eligible for graduate assistantships until they have completed their first or second semester with a 3.0 or higher average. However, students in our masters program have the opportunity to secure rewarding summer and winter internships.

Degrees

- Computer Science (MR) (p. 445)
- Computer Science (MS) (p. 451)
- Computer Science (PhD) (p. 453)
- Computer Science (Certificate) (p. 455)
- Data Science Foundations (Certificate) (p. 457)

Faculty

Full Professors

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Donald L. Bitzer

Rada Yuryevna Chirkova

Jon Doyle

Rudra Dutta

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Xiaohui Gu

Christopher Graham Healey

James C. Lester II

Timothy James Menzies

Rainer Frank Mueller

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Ketchiozo Thierry Wandji

Emeritus Faculty

Wu-show Chou

Edward Willmore Davis Jr.

Robert Joseph Fornaro

Thomas Lynn Honeycutt

David Franklin McAllister

Woodrow Robbins

William James Stewart

Alan Lee Tharp

David J. Thuente

Adjunct professors

Robert Loftin

Bradford Wayne Mott

Computer Science (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Computer Science" without track specifications. Students may request a department letter upon successful completion of a track curriculum.

Master of Computer Science (MR)

Code	Title	Hours	Counts towards
Core Courses		**9**	
Select a minimum of three courses from "Core Courses" listed below			
Required Course		**1**	
CSC 600	Computer Science Graduate Orientation		
Electives Courses		**12**	
CSC 500 or 700-level courses			
Electives or Other Restricted Electives		**9**	
Take any combination of 500- or 700-level courses in Computer Science, the College of Engineering or the College of Sciences			
Total Hours		**31**	

Core Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses: one from either category with two from the remaining category		**9**	
Theory			
CSC 503	Computational Applied Logic	3	
CSC 505	Design and Analysis Of Algorithms	3	

CSC 512	Compiler Construction	3
CSC 514	Foundations of Cryptography	3
CSC 565	Graph Theory	3
CSC 579	Introduction to Computer Performance Modeling	3
CSC 580	Numerical Analysis I	3
CSC 707	Automata, Languages and Computability Theory	3
Systems Category		
CSC 501	Operating Systems Principles	3
CSC 506	Architecture Of Parallel Computers	3
CSC 510	Software Engineering	3
CSC 520	Artificial Intelligence I	3
or CSC 720	Artificial Intelligence II	
CSC 540	Database Management concepts and Systems	3
CSC 561	Principles of Computer Graphics	3
CSC 570	Computer Networks	3
or CSC 573	Internet Protocols	
CSC 574	Computer and Network Security	3

Master of Computer Science (MR) with Data Science Track

Code	Title	Hours	Counts towards
Required Courses		**4**	
CSC 591	Special Topics In Computer Science (Foundations of Data Science)		
CSC 600	Computer Science Graduate Orientation		
Data Science		**6**	
Any two courses from the "Algorithmics" Category listed below			
Data Science Electives		**9**	
Select three courses from at least two categories listed below			
Computer Science Core Courses, Graduate Electives or Restricted Electives		**12**	
Take any combination from the available categories listed below			
Total Hours		**31**	

Algorithmics Category

Code	Title	Hours	Counts towards
CSC 505	Design and Analysis Of Algorithms	3	
CSC 520	Artificial Intelligence I	3	
CSC 522	Automated Learning and Data Analysis	3	
CSC 720	Artificial Intelligence II	3	
CSC 722	Advanced Topics in Machine Learning	3	
CSC 591	Special Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)	1-6	

CSC 791	Advanced Topics In Computer Science (Topics include: Graph Data Mining; Spatial and Temporal Data Mining; Machine Learning for User Adaption; Advanced Algorithms; Algorithms for Data Guided Business Intelligence)	1-6

Systems Category

Code	Title	Hours	Counts towards
CSC 540	Database Management concepts and Systems	3	
CSC 541	Advanced Data Structures	3	
CSC 547	Cloud Computing Technology	3	
CSC 548	Parallel Systems	3	
CSC 591	Special Topics In Computer Science	1-6	
CSC 724	Advanced Distributed Systems	3	
CSC 742	Advanced Topics in Database Management Systems	3	
CSC 750	Service-Oriented Computing	3	

Applications Category

Code	Title	Hours	Counts towards
CSC 530	Computational Methods for Molecular Biology	3	
CSC 554	Human-Computer Interaction	3	
CSC 555	Social Computing and Decentralized Artificial Intelligence	3	
CSC 561	Principles of Computer Graphics	3	
CSC 591	Special Topics In Computer Science (Topics Include: Spoken Dialogue Systems; Intelligent Game Learning; Educational Data Mining)	1-6	

Master of Computer Science (MR) with Security Track

Code	Title	Hours	Counts towards
Required Courses		**4**	
CSC 574	Computer and Network Security		
CSC 600	Computer Science Graduate Orientation		
Security Core Courses		**9**	
Select three courses from "Security Core Courses" listed below			
Security Foundations Courses		**9**	
Select three courses from at least two categories under "Security Foundations Courses" listed below			
Computer Science Core Courses, Graduate Electives or Restricted Electives		**9**	
Take any combination from the available categories listed below			
Total Hours		**31**	

Security Core Courses

Code	Title	Hours	Counts towards
Select three of the following courses:		**9**	
CSC 514	Foundations of Cryptography	3	
CSC 515	Software Security	3	
CSC 705	Operating Systems Security	3	
CSC 774	Advanced Network Security	3	
CSC 533	Privacy in the Digital Age	3	

CSC 591	Special Topics In Computer Science (Specifically: Systems Attacks and Defenses)	1-6

Security Foundation Courses

Code	Title	Hours	Counts towards
Select three courses from at least two categories below:		**9**	
Systems Foundations			
CSC 501	Operating Systems Principles	3	
CSC 510	Software Engineering	3	
CSC 540	Database Management concepts and Systems	3	
CSC 548	Parallel Systems	3	
CSC 570	Computer Networks	3	
CSC 573	Internet Protocols	3	
CSC 575	Introduction to Wireless Networking	3	
CSC 712	Software Testing and Reliability	3	
CSC 724	Advanced Distributed Systems	3	
Theory Foundations			
CSC 505	Design and Analysis Of Algorithms	3	
CSC 512	Compiler Construction	3	
CSC 541	Advanced Data Structures	3	
CSC 565	Graph Theory	3	
CSC 707	Automata, Languages and Computability Theory	3	
CSC 722	Advanced Topics in Machine Learning	3	
Privacy Foundations			
CSC 522	Automated Learning and Data Analysis	3	
CSC 554	Human-Computer Interaction	3	
CSC 555	Social Computing and Decentralized Artificial Intelligence	3	
CSC 591	Special Topics In Computer Science (Specifically: Foundations of Data Science)	1-6	

Master of Computer Science (MR) with Software Engineering Track

Code	Title	Hours	Counts towards
Required Courses			
CSC 510	Software Engineering		
CSC 600	Computer Science Graduate Orientation		
Software Science Courses		**9**	
Select three courses from "Software Science Courses" listed below			
Software Foundations Courses		**6**	
Select two courses from "Software Foundations Courses" listed below			
Computer Science Core Courses, Graduate Electives or Restricted Electives		**12**	
Take any combination from the available categories listed below			
Thesis Research Projects		**N/A**	
Thesis Research Project opportunities will be communicated by faculty			
Total Hours		**27**	

Software Science Courses

Code	Title	Hours	Counts towards
Select three courses from the following:		**9**	
CSC 515	Software Security	3	
CSC 519	DevOps: Modern Software Engineering Practices	3	

CSC 591	Special Topics In Computer Science	1-6	
CSC 710	Software Engineering as a Human Activity	3	
CSC 712	Software Testing and Reliability	3	
CSC 791	Advanced Topics In Computer Science (Specifically: Automated Software Engineering)	1-6	

Software Foundations

Code	Title	Hours	Counts towards
Select two courses from the following:		**6**	
CSC 503	Computational Applied Logic	3	
CSC 512	Compiler Construction	3	
CSC 517	Object-Oriented Design and Development	3	
CSC 520	Artificial Intelligence I	3	
CSC 522	Automated Learning and Data Analysis	3	
CSC 540	Database Management concepts and Systems	3	
CSC 547	Cloud Computing Technology	3	
CSC 554	Human-Computer Interaction	3	
CSC 750	Service-Oriented Computing	3	

Additional Requirements

1. At least 21 hours must be in graduate 500- and 700-level Computer Science courses (note: the Graduate School does not allow 500- and 700-level courses to be taken pass-fail).
2. "Restricted elective" courses may be any graduate letter-graded (500- or 700-level) course within the College of Engineering (including Computer Science), or within the College of Sciences. Exceptions that will *not* count towards graduation:
   - ST 511(if taken after Spring 2014)
   - special topics courses (including EGR 590) in departments other than Computer Science (if taken after Fall 2012).
3. All Computer Science credits must be at or above the 500 level.
4. To graduate, a student must have at least a 3.00 grade point average (GPA). In addition, for students beginning their degree on or after Fall 2013, the GPA in the group of courses used to satisfy the core course requirement must be at least 3.0 as well. For additional Graduate School requirements regarding degree completion see the Graduate School Handbook.
5. A maximum of four special topics courses (either CSC 591 or CSC 791) may be counted towards graduation (for students beginning Fall 2012 or later).
6. Registration by MCS students in Independent Study (CSC 630) requires approval by the faculty member who will supervise the work, followed by submission to the DGP of a one page written description of the topic and expected outputs, and approval of the DGP. A grade of "S" will require submission of a report describing the work done, and the results obtained. A maximum of three credits of CSC 630 may be counted towards graduation.
7. Minors are neither required nor permitted.

Accelerated Bachelor's/Master's Degree Requirements

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This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Computer Science (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
Select a minimum of one course per category under "Core Courses" listed below			
Required Courses		**7**	
CSC 600	Computer Science Graduate Orientation		
CSC 695	Master's Thesis Research		
Elective Courses		**9**	
CSC 500 or 700-level courses			
Minor Courses, CSC Graduate Electives or Restricted Electives		**9**	
"Minor Courses, CSC Graduate Electives or Restricted Electives" will be approved in conjunction with the academic committee			
Total Hours		**31**	

Core Courses

Code	Title	Hours	Counts towards
Select minimum of two courses, one from each category		**6**	
Theory Category			
CSC 503	Computational Applied Logic	3	
CSC 505	Design and Analysis Of Algorithms	3	
CSC 512	Compiler Construction	3	
CSC 514	Foundations of Cryptography		
CSC 565	Graph Theory	3	
CSC 579	Introduction to Computer Performance Modeling	3	
CSC 580	Numerical Analysis I	3	
Systems Category			
CSC 501	Operating Systems Principles	3	
CSC 506	Architecture Of Parallel Computers	3	
CSC 510	Software Engineering	3	
CSC 520	Artificial Intelligence I	3	
or CSC 720	Artificial Intelligence II		
CSC 540	Database Management concepts and Systems	3	
CSC 561	Principles of Computer Graphics	3	
CSC 570	Computer Networks	3	
or CSC 573	Internet Protocols		
CSC 574	Computer and Network Security	3	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

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Computer Science (PhD)

Doctor of Philosophy in Computer Science (PhD)

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select four courses - two from each category - within "Core Courses" listed below			
Required Courses		**13**	
CSC 600	Computer Science Graduate Orientation		
CSC 890	Doctoral Preliminary Exam		
CSC 700-level Courses (two or more)			
Elective / Research Courses		**47**	
"Elective / Research Courses" are approved in conjunction with the academic committee			
Total Hours		**72**	

Core Courses

Code	Title	Hours	Counts towards
Select four courses with two from each category		**12**	
Theory Category			
CSC 503	Computational Applied Logic	3	
CSC 505	Design and Analysis Of Algorithms	3	
CSC 512	Compiler Construction	3	
CSC 514	Foundations of Cryptography		
CSC 565	Graph Theory	3	
CSC 579	Introduction to Computer Performance Modeling	3	
CSC 580	Numerical Analysis I	3	
CSC 707	Automata, Languages and Computability Theory	3	
Systems Category			
CSC 501	Operating Systems Principles	3	
CSC 506	Architecture Of Parallel Computers	3	
CSC 510	Software Engineering	3	
CSC 520	Artificial Intelligence I	3	
or CSC 720	Artificial Intelligence II		
CSC 540	Database Management concepts and Systems	3	
CSC 561	Principles of Computer Graphics	3	
CSC 570	Computer Networks	3	
or CSC 573	Internet Protocols		
CSC 574	Computer and Network Security	3	

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Computer Science (Certificate)

Those interested in developing their computer science knowledge and skills, but not ready to commit to a degree program, might consider the online/on-campus Computer Science Graduate Certificate. Students who complete the certificate will gain in-depth knowledge in Computer Science concepts, methods and tools. Applicants are expected to have an accredited Bachelor of Science degree in Computer Science or any sciences or engineering discipline. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

Certificate in Computer Science

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select a minimum of four CSC courses at the 500- or 700-level – see optional tracks listed below		
Total Hours		**12**	

Computer Science Foundations Track

Code	Title	Hours	Counts towards
Theory Core			
Complete two		6	
CSC 503	Computational Applied Logic		
CSC 505	Design and Analysis Of Algorithms		
CSC 512	Compiler Construction		
CSC 565	Graph Theory		
CSC 574	Computer and Network Security		
CSC 579	Introduction to Computer Performance Modeling		
CSC 580	Numerical Analysis I		
CSC 707	Automata, Languages and Computability Theory		
Systems Core			
Complete two		6	
CSC 501	Operating Systems Principles		
CSC 506	Architecture Of Parallel Computers		
CSC 510	Software Engineering		
CSC 514	Foundations of Cryptography		
CSC 520	Artificial Intelligence I		
CSC 540	Database Management concepts and Systems		
CSC 561	Principles of Computer Graphics		

CSC 570	Computer Networks	
Total Hours		**12**

Networking Track

Code	Title	Hours	Counts towards
Core Courses			
Complete at least one		3-6	
CSC 570	Computer Networks		
CSC 573	Internet Protocols		
Elective Courses			
Complete at least two		6-9	
CSC 574	Computer and Network Security		
CSC 575	Introduction to Wireless Networking		
CSC 577	Switched Network Management		
CSC 591	Special Topics In Computer Science (Topics Include: Internet of Things Analytics; Software Defined NetworkingInterne of Things: Application and Implementation; Internet of Things: A Primer; Network Design and Management; Network Science;)		
CSC 773	Advanced Topics in Internet Protocols		
CSC 774	Advanced Network Security		
Total Hours		**12**	

Security/Privacy Track

Code	Title	Hours	Counts towards
Core Course			
Following courses is required to complete the Security/Privacy Track:			
CSC 574	Computer and Network Security	3	
Elective Courses			
Complete at least three		9	
CSC 514	Foundations of Cryptography		
CSC 515	Software Security		
CSC 705	Operating Systems Security		
CSC 533	Privacy in the Digital Age		
CSC 591	Special Topics In Computer Science		
Total Hours		**12**	

Systems Track

Code	Title	Hours	Counts towards
Core Courses			
Complete at least one		3-6	
CSC 501	Operating Systems Principles		
CSC 548	Parallel Systems		
Elective Courses			
Complete at least two		6-9	
CSC 506	Architecture Of Parallel Computers		
CSC 512	Compiler Construction		
CSC 547	Cloud Computing Technology		
CSC 568	Enterprise Storage Architecture		
CSC 591	Special Topics In Computer Science (Topics Include: Data-Intensive Computing; Reliable Time Computer Systems)		
CSC 714	Real Time Computer Systems		
CSC 724	Advanced Distributed Systems		
CSC 766	Code Optimization for Scalar and Parallel Programs		
Total Hours		**12**	

Data Science Foundations (Certificate)

This online/on-campus program is well suited for working professionals who have some formal training in Computer Science and/or Statistics and wish to acquire a basic understanding of data science. Applicants are expected to have an accredited Bachelor of Science degree in either a sciences or engineering discipline, Computer Science or Statistics. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

Certificate in Data Science Foundations

Code	Title	Hours	Counts towards
Required Courses		**6-9**	
Complete a minimum of two courses from "Core Courses" listed below			
Elective Courses		**3-6**	
Complete minimum of one course from "Elective Courses" listed below			
Total Hours		**12**	

Required Courses

Code	Title	Hours	Counts towards
Select minimum of two courses from the following: [1]		**6-9**	
CSC 505	Design and Analysis Of Algorithms		
CSC 541	Advanced Data Structures		
ST 517	Applied Statistical Methods I		
ST 563	Introduction to Statistical Learning		

Elective Courses

Code	Title	Hours	Counts towards
Select minimum of one course from the following		**3-6**	
CSC 522	Automated Learning and Data Analysis [2]		
CSC 540	Database Management concepts and Systems		
CSC 591	Special Topics In Computer Science (Topics include: Data Driven Business Intelligence; Graph Data Mining; Spatial and Temporal Data Mining)		
ST 540	Applied Bayesian Analysis		

1 Students must take at least one ST and one CSC course

2 Credit cannot be given for both CSC 522 Automated Learning and Data Analysis and ST 563 Introduction to Statistical Learning

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Electric Power Systems Engineering

The Master of Science in Electric Power Systems Engineering (MS-EPSE) gives students a thorough understanding of the tools, methods, and practice of electric power engineering. It is both focused and practical in its orientation, with the goal of providing an education that is directly applicable to a career in industry.

The MS-EPSE degree is an accelerated program suitable for a new or recent graduate, as well as experienced professionals who want to receive the necessary retraining to change careers. The program is offered both in-class and as an online degree.

Admission Requirements

Students must have a bachelor's degree from an accredited college or university in electrical engineering with an overall GPA of at least 3.0. Students who do not have a bachelor's degree from an accredited college or university in electrical engineering must satisfy:

1. Completion of the following ECE courses (or electrical engineering courses equivalent to ECE 200, 211, 220, 301, and 303.
2. Applicants must have also completed the following courses or equivalent courses: three semesters of calculus, one semester of probability/statistics, two semesters of physics, and one semester of chemistry.

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NC State may be waived.

Three strong recommendations from persons able to comment on the applicant's qualifications for graduate study.

All non-US citizen applicants (i.e., non-resident aliens and permanent residents) must demonstrate proficiency in English at a level necessary to be successful in a graduate program at NC State University. The TOEFL or IELTS test must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum score of 18 on the Listening, Reading and Writing sections, 19 on the Speaking section, and a minimum Total score of 90. On the IELTS, students must have a minimum score of 6.5 on the Listening, Reading and Writing sections, 7.0 on the Speaking section, and a minimum Overall Band Score of 6.5. Scores on previous versions of the TOEFL and IELTS are considered with the same qualitative standard. The TOEFL and IELTS tests will be waived if the applicant is a citizen of a country where English is an official language and the language of instruction in higher education or if the applicant has successfully completed at least one year of full-time study in a degree program at a four-year US college or university.

TOEFL - institution code 5496; department code 66.
GRE - institution code 5496; department code 1203.

Master’s Degree Requirements

The MS-EPSE program requires 30 credit hours of graduate coursework. Twenty-seven credits include four core electric power engineering courses; two interdisciplinary courses on power electronics, data communications, cyber security and environmental issues associated with electric power systems; professional skills training on project management, communication skills, and the business aspects of electric power utilities, and solid hands-on experience through laboratories and a capstone project. This program provides a one-to-one interaction with industry partners.

Student Financial Support: Student scholarships are available through an application process. Please contact the program manager for further information.

Other Relevant Information

To further promote integration of concepts and provide hands-on experience, the program includes an industry sponsored capstone project.

Degrees

- Electric Power Systems Engineering (MS) (p. 460)
- Electric Power Systems Engineering (MS): Internship Concentration (p. 461)
- Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration (p. 462)

Faculty

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Electric Power Systems Engineering (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18**	
ECE 550	Power System Operation and Control		
ECE 551	Smart Electric Power Distribution Systems		
ECE 552	Renewable Electric Energy Systems		
ECE 583	Electric Power Engineering Practicum I		
ECE 584	Electric Power Engineering Practicum II		
ECE 534	Power Electronics		
or ECE 587	Power System Transients Analysis		
Elective Courses		**12**	
Select a minimum of four of the following:			
ECE 516	System Control Engineering		
ECE 534	Power Electronics		
ECE 535	Design of Electromechanical Systems		
ECE 554	Electric Motor Drives		
ECE 581	Electric Power System Protection		
ECE 585	The Business of the Electric Utility Industry		
ECE 586	Communication and SCADA Systems for Smart Grid		
ECE 587	Power System Transients Analysis		
ECE 589	Solid State Solar and Thermal Energy Harvesting		
ECE 592	Special Topics In Electrical Engineering		
ECE 726	Advanced Feedback Control		
ECE 732	Dynamics and Control of Electric Machines		
ECE 736	Power System Stability and Control		
ECE 753	Computational Methods for Power Systems		
CE 578	Energy and Climate		
Total Hours		**30**	

Accelerated Bachelor's/Master's Degree Requirements

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This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Electric Power Systems Engineering (MS): Internship Concentration

Degree Requirements

This concentration will require an Internship of at least four months duration (maximum of seven months) and the student to take 3 credit hours of ECE 650 and obtain a Satisfactory grade. An internship of at least four calendar months duration would require that it span at least one semester and possibly part of summer. The credits for ECE 650 would be taken during the semester that includes the internship. The student would be considered as being enrolled full time during that semester.

A student would not enroll in this concentration in their first semester. They would switch to it in a later semester if they secure a suitable internship. Per normal CPT rules, International students studying on an F-1 visa would have to be present on a US campus for two full semesters (a full academic year), and present at NC State for one semester, before using CPT privileges to take an internship. If a student switches to this concentration but does not start the internship, they will switch back to the original plan.

This will be a concentration only for on-campus students. Students enrolled in our distance education – Engineering Online (EOL) - option will not be eligible.

Code	Title	Hours	Counts towards
Core Courses		**18**	
ECE 550	Power System Operation and Control		
ECE 551	Smart Electric Power Distribution Systems		
ECE 552	Renewable Electric Energy Systems		
ECE 583	Electric Power Engineering Practicum I		
ECE 584	Electric Power Engineering Practicum II		
ECE 534	Power Electronics		
or ECE 587	Power System Transients Analysis		
Concentration Requirement		**3**	
ECE 650	Internship *		
Elective Courses		**9**	
Select a minimum of four of the following:			
ECE 516	System Control Engineering		
ECE 534	Power Electronics		
ECE 535	Design of Electromechanical Systems		
ECE 554	Electric Motor Drives		
ECE 581	Electric Power System Protection		
ECE 585	The Business of the Electric Utility Industry		
ECE 586	Communication and SCADA Systems for Smart Grid		
ECE 587	Power System Transients Analysis		

ECE 589	Solid State Solar and Thermal Energy Harvesting	
ECE 592	Special Topics In Electrical Engineering	
ECE 726	Advanced Feedback Control	
ECE 732	Dynamics and Control of Electric Machines	
ECE 736	Power System Stability and Control	
ECE 753	Computational Methods for Power Systems	
CE 578	Energy and Climate	
Total Hours		**30**

* ECE 650 requires that a written report be submitted and accepted by an ECE faculty examiner as meeting the standards required by the course. The written report should cover both technical and non-technical aspects of what the student did and learned during the internship. The report should not disclose company proprietary information.

Faculty

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Electric Power Systems Engineering (MS): Wide Bandgap Power Electronics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Curriculum		**18**	
ECE 534	Power Electronics		
ECE 553	Semiconductor Power Devices		
ECE 592	Special Topics In Electrical Engineering		
ECE 583	Electric Power Engineering Practicum I		
ECE 792	Special Topics In Electrical Engineering		
ECE 584	Electric Power Engineering Practicum II		
or ECE 592	Special Topics In Electrical Engineering		
Wide Band Gap Concentration		**12**	
Select twelve credit hours of the following courses:			
ECE 511	Analog Electronics		
ECE 516	System Control Engineering		
ECE 533	Power Electronics Design & Packaging		

ECE 536	Digital Control System Projects	
ECE 552	Renewable Electric Energy Systems	
ECE 554	Electric Motor Drives	
ECE 561	Embedded System Design	
ECE 732	Dynamics and Control of Electric Machines	
ECE 734	Power Management Integrated Circuits	
ECE 739	Integrated Circuits Technology and Fabrication Laboratory	
ECE 792	Special Topics In Electrical Engineering	
ISE 515	Manufacturing Process Engineering	
Total Hours		**30**

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Electrical Engineering

The Master of Science in Electrical Engineering may be earned with thesis option or non-thesis option. Either option may be used as preparation for further graduate study or employment in industrial research, development or design.

Also a strong Ph.D. program is available for those who wish to pursue a research and/or teaching career in Industry, Government or Academia.

Admissions Requirements

Admission to the M.S. program requires a B.S. in electrical engineering, computer engineering or computer science, and an overall undergraduate GPA of at least 3.0. For non-native English speakers, the minimum acceptable TOEFL score for admission to the M.S. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but may be waived upon request for graduates from US Universities (see below). Admission is further limited by available room in the elected program of study. Meeting the above minimum requirements alone does not guarantee admission.

Applicants to the Master's and PhD programs who do not have a Bachelor's degree in Electrical Engineering or Computer Engineering, but have a closely related degree from an accredited college or university, must have taken the following pre-requisite courses: Courses equivalent to ECE 109, ECE 209, ECE 212, ECE 220, ECE 301, ECE 302 and ECE 303.

GRE scores within the last four years of the date of anticipated admission. Guideline for minimal GRE percentile scores are 70 percentile verbal, 90 percentile quantitative, and 50 percentile analytical or writing. GRE scores for students who are graduates from NC State may be waived. They also might be waived for graduates from US ABET accredited programs with good GPAs.

All international applicants from non English speaking countries must submit TOEFL scores. The TOEFL must have been taken within two years of the date of anticipated admission. On the TOEFL iBT, students must have a minimum of 18 on each section of the test with a minimum total of 90. Scores on previous versions of the TOEFL are considered with the same qualitative standard. On the IELTS, we require a minimum score of 6.5 in each section. This requirement also applies to US citizens

whose principal language of instruction has not been English (for example, most applicants from Puerto Rico and the Virgin Islands).

TOEFL - institution code 5496; department code 66
GRE - institution code 5496; department code 1203

Admission to the Ph.D. program requires a B.S. or M.S. in electrical engineering, computer engineering or computer science with an expectation of an overall GPA of at least 3.25. The minimum acceptable TOEFL score for admission to the Ph.D. program is 90 (minimum 18 in each area, with minimum of 19 on Speaking). The GRE is required for all programs of study but might be waived for NC State graduates or graduates from other US ABET accredited schools with good GPAs. Admission is further limited by available room in the elected program of study, and meeting the minimum requirements as given above does not guarantee admission.

Master's Degree Requirements

Thirty-one (31) credit hours; a thesis is optional. Students must have at least 21 hours of ECE courses that cover at least three specialty areas and have at least three credit hours of advanced-level (700-level) ECE courses. Students electing the Option B non-thesis option must meet core course requirements; have ECE courses that cover at least three specialty areas' and have at least three credit hours of 700-level ECE courses.

The Master's degree is offered online through Engineering OnLine. Applications to these MS on-line programs are through the ECE Department and all students must comply with ECE program requirements.

Doctoral Degree Requirements

Approximately 54 credit hours are required beyond the M.S. degree or 72 credit hours beyond the B.S. degree. For those with an NC State MS degree in our department, no additional courses are required. For those with an NC State MS degree in another department, 6 credit hours are required in our department. For those with a non NC State MS degree, 12 credit hours of coursework are required. For those with only a Bachelors degree 30 credit hours of coursework are required. The remaining credit hours are research.

The department wishes to evaluate a Ph.D. student's research potential as quickly as possible. Consequently, all Ph.D. students are required to pass a qualifying review before the end of their third semester of study. This review is based on the student's academic performance to date and the results of a project with one of their committee members. Results are presented to the committee in both written and oral form. Based on this review, the committee will decide if the student may continue in the Ph.D. program.

Student Financial Support

The department offers financial support to qualified students in the form of teaching assistantships, research assistantships, and fellowships. These sources of support generally include coverage of tuition and fees.

Degrees

- Electrical Engineering (MS) (p. 466)
- Electrical Engineering (MS): Internship Concentration (p. 468)
- Electrical Engineering (PhD) (p. 471)
- Electrical Engineering (Minor) (p. 473)
- 5G Technologies (Certificate) (p. 475)
- ASIC Design & Verification (Certificate) (p. 477)
- Electrical Engineering (Certificate) (p. 479)
- Nano-Systems Engineering (Certificate) (p. 481)
- Renewable Electric Energy Systems (Certificate) (p. 482)

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Electrical Engineering (MS)

Master of Science Degree Requirements

Degrees earned will be distributed as: "Master of Science in Electrical Engineering" without specialty or option specifications.

Code	Title	Hours	Counts towards
Required Courses		**1**	
ECE 600	ECE Graduate Orientation		
Core Courses [1]		**21**	
"Core Courses" are approved in conjunction with the academic committee			
Depth Courses	Select at least three credit hours of 700-level courses		
Major Courses	Select at least 15 credit hours of EE courses		
Breadth Course	Select at least three credit hours in different ECE specialites		
Additional Courses		**9**	
"Additional Courses" are approved in conjunction with the academic committee to meet 31 total hours			
Total Hours		**31**	

1 Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Electrical Engineering (MS): Internship Concentration

Degree Requirements

This concentration will require an Internship of at least four months duration (maximum of seven months) and the student to take 3 credit hours of ECE 650 and obtain a Satisfactory grade. An internship of at least four calendar months duration would require that it span at least one semester and possibly part of summer. The credits for ECE 650 would be taken during the semester that includes the internship. The student would be considered as being enrolled full time during that semester.

A student would not enroll in this concentration in their first semester. They would switch to it in a later semester if they secure a suitable internship. Per normal CPT rules, International students studying on an F-1 visa would have to be present on a US campus for two full semesters (a full academic year), and present at NC State for one semester, before using CPT privileges to take an internship. If a student switches to this concentration but does not start the internship, they will switch back to the original plan.

This will be a concentration only for on-campus students. Students enrolled in our distance education – Engineering Online (EOL) - option will not be eligible.

Code	Title	Hours	Counts towards
Required Courses		**1**	
ECE 600	ECE Graduate Orientation		
Core Courses [1]		**21**	
"Core Courses" are approved in conjunction with the academic committee			
Depth Courses	Select at least three credit hours of 700-level courses		
Major Courses	Select at least 15 credit hours of EE courses		

Breadth Course	Select at least three credit hours in different ECE specialites	
Concentration Requirement		**3**
ECE 650	Internship	
Additional Courses		**6**
"Additional Courses" are approved in conjunction with the academic committee to meet 31 total hours		
Total Hours		**31**

1 Students are only allowed three credit hours of ECE 633, ECE 634, ECE 650, ECE 695 (for Thesis students).

2 ECE 650 requires that a written report be submitted and accepted by an ECE faculty examiner as meeting the standards required by the course. The written report should cover both technical and non-technical aspects of what the student did and learned during the internship. The report should not disclose company proprietary information.

Faculty

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Electrical Engineering (PhD)

Degree Requirements

Degrees earned will be distributed as: "Doctor of Philosophy Electrical Engineering" without track specifications.

Code	Title	Hours	Counts towards
Required Courses		**72**	
ECE 600	ECE Graduate Orientation		
Select a minimum of two 700-level ECE courses			
Select a Master's Track			
ECE 833	Individual Topics In Electrical Engineering		
ECE 834	Individual Studies In Electrical Engineering		
ECE 895	Doctoral Dissertation Research		
Total Hours		**72**	

Master's Tracks

Code	Title	Hours	Counts towards
Non-NCSU Masters Requirements			
Select six credit hours		6	
Select six additional credit hours (ECE or other)		6	
Total Hours		**12**	

Code	Title	Hours	Counts towards
Requirements for Students w/out Master's Degree			
Select 18 ECE credit hours		18	
Select 12 additional credit hours (ECE or other)		12	
Total Hours		**30**	

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Electrical Engineering (Minor)

Plan Requirements

Master's Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select at least three 500- or 700-level courses approved in conjunction with the academic committee		
Total Hours		**9**	

PhD Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select at least four 500-level or above courses approved in conjunction with the academic committee		
Total Hours		**12**	

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5G Technologies (Certificate)

Plan Requirements

Students may choose from the course tracks below to complete coursework within a focus area.

Certificates earned will be distributed as: "Graduate Certificate in 5G Technologies" without focus area track specifications.

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECE 592	Special Topics In Electrical Engineering (LTE and 5G Communications (EOL))		
Select a course sequence under any track area listed under "Focus Area Tracks"			
Total Hours		**12**	

Focus Area Tracks

Circuits

Code	Title	Hours	Counts towards
Course Sequence			
ECE 511	Analog Electronics		
ECE 712	Integrated Circuit Design for Wireless Communications		
ECE 792	Special Topics In Electrical Engineering (Design of Millimeter-Wave Circuits and Systems (EOL))		

Microwave Systems and Applied EM

Code	Title	Hours	Counts towards
Course Sequence			
ECE 524	Radio System Design		
ECE 549	RF Design for Wireless		
ECE 592	Special Topics In Electrical Engineering (Antennas and Arrays)		

Communications

Code	Title	Hours	Counts towards
Course Sequence			
ECE 575	Introduction to Wireless Networking		
ECE 766	Signal Processing for Communications & Networking		
ECE 570	Computer Networks		

Faculty

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Yan Solihin

ASIC Design & Verification (Certificate)

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECE 564	ASIC and FPGA Design with Verilog		
ECE 745	ASIC Verification		
ECE 748	Advanced Functional Verification with Universal Verification Methodology		
ECE 546	VLSI Systems Design		
or ECE 720	Electronic System Level and Physical Design		
Total Hours		**12**	

Faculty

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Yan Solihin

Electrical Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four ECE courses at the 500- or 700-level			
Total Hours		**12**	

* Courses must be Electrical Engineering or cross-listed as either. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

Faculty

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Nano-Systems Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems	3	
MBA 576	Technology Entrepreneurship and Commercialization I	3	
Micro-Machined Sensors and Actuators			
Select six credit hours of the following Core Electives:		6	
BME 590	Special Topics in Biomedical Engineering (Nanobiotechnolo		
BME 590	Special Topics in Biomedical Engineering (Biosensors)		
CHE 596	Special Topics in Chemical Engineering (Nano-scale films and surfaces)		
CHE 596	Special Topics in Chemical Engineering (Colloid Science and Nano-Scale Engineering)		
ECE 538	Integrated Circuits Technology and Fabrication		
ECE 739	Integrated Circuits Technology and Fabrication Laboratory		

ECE 792	Special Topics In Electrical Engineering (Self-Powered Nano-Systems)	
ECE 592	Special Topics In Electrical Engineering (Micro-Machined Sensors and Actuators)	
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing	
MAE 536	Micro/Nano Electromechanical Systems	
MAE 589	Special Topics In Mechanical and Aerospace Engineering (Micro-transducers)	
MSE 760	Materials Science in Processing of Semiconductor Devices	
MSE 771	Materials Science of Nanoelectronics	
MSE 791	(Introduction to Nano-Materials)	
Select three hours of the following Technical Electives:		3
BME 525	Bioelectricity	
BME 566	Polymeric Biomaterials Engineering	
ECE 557	Principles Of MOS Transistors	
ECE 724	Electronic Properties Of Solid-State Devices	
ECE 723	Optical Properties Of Semiconductors	
ECE 530	Physical Electronics	
ECE 592	Special Topics In Electrical Engineering (Bioelectricity and Neural Interfaces)	
ECE 592	Special Topics In Electrical Engineering (Organic Electronics and LCDs)	
ISE 714	Product Manufacturing Engineering for the Medical Device Industry	
Total Hours		**15**

Renewable Electric Energy Systems (Certificate)

The Graduate Certificate in Renewable Electric Energy Systems provides graduate students with the opportunity to develop expertise in renewable electric energy systems and advanced electric power grid technology in addition to their major area of graduate study.

Admissions

Applicants with appropriate background must meet one of the three following requirements:

- be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- be a degree student in good standing in an NC State University graduate program; or
- have a Master's degree in a related field of study.

A student may obtain more than one graduate certificate in a different field. Each certificate must have at least nine (9) credit hours that are unique to it.

Requirements

The Graduate Certificate in Renewable Electric Energy Systems requires a minimum of 12 hours, including one 3-hour core course and 9 credit hours of electives to be selected from a list that contains relevant courses for the certificate. Students must maintain a minimum overall GPA of B (3.0).

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECE 552	Renewable Electric Energy Systems	3	
Select three of the following Advanced Courses:		9	
ECE 550	Power System Operation and Control		
ECE 581	Electric Power System Protection		

ECE 534	Power Electronics	
ECE 551	Smart Electric Power Distribution Systems	
ECE 535	Design of Electromechanical Systems	
ECE 585	The Business of the Electric Utility Industry	
ECE 589	Solid State Solar and Thermal Energy Harvesting	
ECE 736	Power System Stability and Control	
Total Hours		**12**

Engineering

The Master of Engineering (MR) distance education degree program is designed for students with an undergraduate degree in engineering or a closely related field who wish to pursue a graduate degree in engineering. The program was created to address the needs of students whose schedule or location does not allow on-campus study, working professionals who wish to obtain an advanced degree or those who wish to change fields within engineering. It is a 30-credit-hour degree program which does not require a thesis, final oral exam or on-campus residency. Students design the plan of study which best meets their career or educational goals, taking courses from at least two engineering disciplines to create a general degree program.

Convenience and flexibility are the key advantages of this interdisciplinary degree program that can be earned totally at a distance with no GRE, thesis, or final oral exam requirements. The Master of Engineering degree allows students to choose from different subplans from the many disciplines of engineering within the College of Engineering or to design their own degree plans that best meet their career or employment goals. Students must identify an area of concentration from which they will complete 3 to 6 classes. **All concentration area classes MUST be taken from the College of Engineering at NC State University.** The concentration will appear on the student's transcript if 5 or 6 courses are taken in that specialty area. **No double concentration is allowed** (5 in one area plus 5 in another area). **No more than 6** classes will be allowed in a single area.

The program does not offer financial assistance. The Office of Scholarships and Financial Aid (OSFA) assists students in applying for and securing financial assistance for educational expenses. OSFA can help with all questions about financial aid, and guide students to available scholarships, grants, and loans.

Degrees

- Engineering (MR) (p. 484)
- Engineering (MR): Aerospace Engineering Concentration (p. 484)
- Engineering (MR): Chemical Engineering Concentration (p. 485)
- Engineering (MR): Computer Engineering Concentration (p. 486)
- Engineering (MR): Computer Science Concentration (p. 487)
- Engineering (MR): Engineering Management Concentration (p. 488)
- Engineering (MR): Industrial Engineering Concentration (p. 489)
- Engineering (MR): Materials Science and Engineering Concentration (p. 489)
- Engineering (MR): Mechanical Engineering Concentration (p. 490)
- Engineering (MR): Nuclear Engineering Concentration (p. 491)

Faculty

Full Professors

Morton A. Barlaz

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Practice/Research/Teaching Professors

Lisa G. Bullard

Adjunct Faculty

Linda D. Krute

Engineering (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Faculty

Full Professors

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Engineering (MR): Aerospace Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	

"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *	
Total Hours	**30**

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Aerospace Engineering specialty

Faculty

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Engineering (MR): Chemical Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Chemical Engineering

Faculty

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Linda D. Krute

Engineering (MR): Computer Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Computer Engineering

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Linda D. Krute

Engineering (MR): Computer Science Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Computer Science

Faculty

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Engineering (MR): Engineering Management Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Engineering Management

Faculty

Full Professors

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Engineering (MR): Industrial Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Industrial Engineering

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Engineering (MR): Materials Science and Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	

"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *	
Total Hours	**30**

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Materials Science and Engineering

Faculty

Full Professors

Morton A. Barlaz

Mohamed Abdelhay Bourham

Mo-Yuen Chow

Jerome J. Cuomo

Alexandra Duel-Hallen

Yahya Fathi

Paul D. Franzon

Edward F. Gehringer

Jan Genzer

Richard David Gould

Christine S. Grant

Saad A. Khan

Carl C. Koch

James M. Nau

Gregory N. Parsons

Harilaos George Perros

Sanmugavadivel Ranjithan

Douglas Stephen Reeves

Georgios Rouskas

Lawrence M. Silverberg

Munindar P. Singh

J. K. Townsend

Henry J. Trussell

Ioannis Viniotis

Mladen Alan Vouk

Associate Professors

Jeffrey W. Eischen

Jerome Philip Lavelle

Practice/Research/Teaching Professors

Lisa G. Bullard

Adjunct Faculty

Linda D. Krute

Engineering (MR): Mechanical Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Mechanical Engineering

Faculty

Full Professors

Morton A. Barlaz

Mohamed Abdelhay Bourham

Mo-Yuen Chow

Jerome J. Cuomo

Alexandra Duel-Hallen

Yahya Fathi

Paul D. Franzon

Edward F. Gehringer

Jan Genzer

Richard David Gould

Christine S. Grant

Saad A. Khan

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Sanmugavadivel Ranjithan

Douglas Stephen Reeves

Georgios Rouskas

Lawrence M. Silverberg

Munindar P. Singh

J. K. Townsend

Henry J. Trussell

Ioannis Viniotis

Mladen Alan Vouk

Associate Professors

Jeffrey W. Eischen

Jerome Philip Lavelle

Practice/Research/Teaching Professors

Lisa G. Bullard

Adjunct Faculty

Linda D. Krute

Engineering (MR): Nuclear Engineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**3-12**	
	"Required Courses" are approved in conjunction with the academic committee *		
Concentration Courses		**9-18**	
	"Concentration Courses" are approved in conjunction with the academic committee		
Additional Online Courses		**9**	
	"Additional Online Courses" are approved in conjunction with the academic committee to meet 30 total hours *		
Total Hours		**30**	

* Courses can be from Engineering or from related fields (Science, Business, Math, etc. with ONLY ONE class allowed in Business) with Advisor Approval

Concentration Requirements

- 30 graduate level, letter graded credit hours
- 21/30 hours engineering classes
- 18/30 hours from College of Engineering, must be from more than one discipline
- 3-6 courses from Nuclear Engineering

Faculty

Full Professors

Morton A. Barlaz

Mohamed Abdelhay Bourham

Mo-Yuen Chow

Jerome J. Cuomo

Alexandra Duel-Hallen

Yahya Fathi

Paul D. Franzon

Edward F. Gehringer

Jan Genzer

Richard David Gould

Christine S. Grant

Saad A. Khan

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Lawrence M. Silverberg

Munindar P. Singh

J. K. Townsend

Henry J. Trussell

Ioannis Viniotis

Mladen Alan Vouk

Associate Professors

Jeffrey W. Eischen

Jerome Philip Lavelle

Practice/Research/Teaching Professors

Lisa G. Bullard

Adjunct Faculty

Linda D. Krute

Engineering Management

The Master of Engineering Management (p. 492) degree deepens your critical analytical, science and engineering talents — Think. It also broadens your crucial management skills — Lead. NC State's Master of Engineering Management degree provides you the skills necessary to manage and succeed in today's complex technical environments.

The Master of Engineering Management degree consists of 10 courses (30 credit hours). Five (5) courses are located in the core curriculum, with the remaining five (5) courses in the student's chosen concentration. Concentrations are as follows:

- Analytics (p. 493)
- Entrepreneurship (p. 494)
- Facilities Engineering (p. 495)
- General (p. 497)
- Health and Human Systems (p. 498)
- Professional Practice (p. 499)
- Supply Chain Engineering & Management (p. 500)

All concentrations include a masters project / practicum course.

Degrees

- Engineering Management (MR) (p. 492)
- Engineering Management (MR): Analytics Concentration (p. 493)
- Engineering Management (MR): Entrepreneurship Concentration (p. 494)
- Engineering Management (MR): Facilities Engineering Concentration (p. 495)
- Engineering Management (MR): General Concentration (p. 497)
- Engineering Management (MR): Health and Human Systems Concentration (p. 498)
- Engineering Management (MR): Professional Practice Concentration (p. 499)
- Engineering Management (MR): Supply Chain Engineering & Management Concentration (p. 500)
- Engineering Management Foundations (Certificate) (p. 501)

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:			
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:			
EGR 501	Engineering Leadership and Strategic Change		

COM 530	Interpersonal Communication in Science and Technology Organizations	
COM 527	Seminar in Organizational Conflict Management	
COM 556	Seminar In Organizational Communication	
Select one of the following courses:		
ISE 754	Logistics Engineering	
BUS 554	Project Management	
CE 561	Construction Project Management	
EGR 590	Special Topics in Engineering (Engineering Project Management)	
Select one of the following courses:		
ISE 510	Applied Engineering Economy	
EGR 505	Managerial Finance for Engineers	
CE 567	Risk and Financial Management in Construction	
Elective Courses		**15**
Select a minimum of five elective courses approved in conjunction with the academic committee		
Total Hours		**30**

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Analytics Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
ISE 754	Logistics Engineering		
BUS 554	Project Management		
CE 561	Construction Project Management		
EGR 590	Special Topics in Engineering (Engineering Project Management)		
Select one of the following courses:		3	

ISE 510	Applied Engineering Economy
EGR 505	Managerial Finance for Engineers
CE 567	Risk and Financial Management in Construction

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select four courses below:		12	
ISE 519	Database Applications in Industrial and Systems Engineering		
ISE 535	Python Programming for Industrial & Systems Engineers		
ISE 537	Statistical Models for Systems Analytics in Industrial Engineering		
MBA 545	Decision Making under Uncertainty		
MBA 590	Special Topics In Business Management (Operations Analysis)		
ST 562	Data Mining with SAS Enterprise Miner		
ST 555	Statistical Programming I		
Select one of the following courses:		3	
EM 675	Engineering Management Masters Project		
ISE 677	Industrial Engineering Projects		
MBA 559	Business Analytics Practicum		
Total Hours		**30**	

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Entrepreneurship Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
ISE 754	Logistics Engineering		
BUS 554	Project Management		

CE 561	Construction Project Management	
EGR 590	Special Topics in Engineering (Engineering Project Management)	
Select one of the following courses:		3
ISE 510	Applied Engineering Economy	
EGR 505	Managerial Finance for Engineers	
CE 567	Risk and Financial Management in Construction	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select four of the following courses:		12	
MBA 536	Experience Innovation and Strategic Design		
MBA 570	Opportunity Evaluation and Value Creation		
MBA 571	High Growth Entrepreneurship		
MBA 572	Venture Opportunity Analytics		
EGR 506	Managing New Hi Tech Product Launches		
EGR 507	Product Life Cycle Management		
EGR 590	Special Topics in Engineering (Managing New Product Creation)		
Select one of the following courses:		3	
EM 675	Engineering Management Masters Project		
MBA 549	Supply Chain Management Practicum		
MBA 559	Business Analytics Practicum		
ISE 521	Healthcare Systems Performance Improvement II		
Total Hours		**30**	

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Facilities Engineering Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		

COM 556	Seminar In Organizational Communication	
Select one of the following courses:		3
ISE 754	Logistics Engineering	
BUS 554	Project Management	
CE 561	Construction Project Management	
EGR 590	Special Topics in Engineering (Engineering Project Management)	
Select one of the following courses:		3
ISE 510	Applied Engineering Economy	
EGR 505	Managerial Finance for Engineers	
CE 567	Risk and Financial Management in Construction	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select three of the following courses:		9	
CE 564	Legal Aspects of Contracting		
CE 565	Construction Safety Management		
TE 533	Lean Six Sigma Quality		
ISE 535	Python Programming for Industrial & Systems Engineers		
ISE 748	Quality Engineering		
CE 578	Energy and Climate		
CE/EGR 590	Special Topics In Civil Engineering (Intro to Facilities Engineering)		
EGR 590	Special Topics in Engineering (Environmental Compliance for Facilities Engineering)		
CE 590	Special Topics In Civil Engineering (Modeling and Analysis of Civil Engineering Systems)		
CE 775	Modeling and Analysis Of Environmental Systems		
CE 504	Airport Planning and Design		
MAE 540	Advanced Air Conditioning Design		
ECE 551	Smart Electric Power Distribution Systems		
Technical Elective		3	
Technical electives are determined in conjunction with the academic committee			
Select one of the following courses:		3	
ISE 677	Industrial Engineering Projects		
MBA 559	Business Analytics Practicum		
CE 675	Civil Engineering Projects		
IMS 675	Manufacturing Systems Engineering Project		
EM 675	Engineering Management Masters Project		
Total Hours		**30**	

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): General Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
ISE 754	Logistics Engineering		
BUS 554	Project Management		
CE 561	Construction Project Management		
EGR 590	Special Topics in Engineering (Engineering Project Management)		
Select one of the following courses:		3	
ISE 510	Applied Engineering Economy		
EGR 505	Managerial Finance for Engineers		
CE 567	Risk and Financial Management in Construction		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select one of the following courses:		3	
EM 675	Engineering Management Masters Project		
ISE 677	Industrial Engineering Projects		
MBA 549	Supply Chain Management Practicum		
MBA 559	Business Analytics Practicum		
ISE 521	Healthcare Systems Performance Improvement II		
Engineering & Management Electives		12	
Engineering & Management electives are determined in conjunction with the academic committee			
Total Hours		**30**	

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Health and Human Systems Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
ISE 754	Logistics Engineering *		
BUS 554	Project Management		
CE 561	Construction Project Management		
EGR 590	Special Topics in Engineering (Engineering Project Management)		
Select one of the following courses:		3	
ISE 510	Applied Engineering Economy		
EGR 505	Managerial Finance for Engineers		
CE 567	Risk and Financial Management in Construction		

* ISE 754 is required for the Supply Chain Engineering & Management (p. 500) concentration

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE 521	Healthcare Systems Performance Improvement II		
Select four of the following courses:		12	
ISE 520	Healthcare Systems Performance Improvement I		
ISE/OR 525	Medical Decision Making		
ISE 533	Service Systems Engineering		
ISE 547	Applications of Data Science in Healthcare		
ISE 562	Simulation Modeling		
ISE 560	Stochastic Models in Industrial Engineering		
TE 533	Lean Six Sigma Quality		
ISE 511	Supply Chain Economics and Decision Making		
ISE 541	Occupational Safety Engrg		
ISE 544	Occupational Biomechanics		
Total Hours		**30**	

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Professional Practice Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
ISE 754	Logistics Engineering *		
BUS 554	Project Management		
CE 561	Construction Project Management		
EGR 590	Special Topics in Engineering (Engineering Project Management)		
Select one of the following courses:		3	
ISE 510	Applied Engineering Economy		
EGR 505	Managerial Finance for Engineers		
CE 567	Risk and Financial Management in Construction		

* ISE 754 is required for the Supply Chain Engineering & Management (p. 500) concentration

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select three of the following courses:		9	
TE 533	Lean Six Sigma Quality		
ISE 519	Database Applications in Industrial and Systems Engineering		
EGR 507	Product Life Cycle Management		
ISE 535	Python Programming for Industrial & Systems Engineers		
ISE 562	Simulation Modeling		
ISE 552	Design and Control of Production and Service Systems		
ISE 748	Quality Engineering		
Engineering Electives		3	
Engineering electives are determined in conjunction with the academic committee			
Management Electives		3	
Management electives are determined in conjunction with the academic committee			
Select one of the following courses:			

EM 675	Engineering Management Masters Project	
ISE 677	Industrial Engineering Projects	
IMS 675	Manufacturing Systems Engineering Project	
Total Hours		**30**

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management (MR): Supply Chain Engineering & Management Concentration

Degree Requirements

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ISE/OR 501	Introduction to Operations Research		
Select one of the following courses:		3	
ST 513	Statistics for Management and Social Sciences I		
ST 515	Experimental Statistics for Engineers I		
ST 516	Experimental Statistics For Engineers II		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
Select one of the following courses:		3	
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Select one of the following courses:		3	
BUS 554	Project Management		
CE 561	Construction Project Management		
EGR 590	Special Topics in Engineering (Engineering Project Management)		
Select one of the following courses:		3	
ISE 510	Applied Engineering Economy		
EGR 505	Managerial Finance for Engineers		
CE 567	Risk and Financial Management in Construction		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Course		**15**	
Select four of the following courses:		12	
MBA 541	Supply Management		
MBA 590	Special Topics In Business Management (Operations Analysis)		
ISE 552	Design and Control of Production and Service Systems		
ISE 553	Modeling and Analysis of Supply Chains		
ISE 754	Logistics Engineering		
MBA 543	Planning and Control Systems		

MBA 590	Special Topics In Business Management (Strategic Operations Management)	
ISE 511	Supply Chain Economics and Decision Making	
ISE 535	Python Programming for Industrial & Systems Engineers	
Select one of the following courses:		3
MBA 549	Supply Chain Management Practicum	
EM 675	Engineering Management Masters Project	
Total Hours		**30**

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Engineering Management Foundations (Certificate)

This certificate is for engineering, STEM, or technical students seeking or experiencing transitions into increasing levels of responsibility and/or management roles. The program provides students the principles and foundational concepts for the planning and operational management of industrial, engineering, and technical organizational pursuits. Students may qualify to have their credits transferred into the Master of Engineering Management (MEM) (p. 492) degree program.

The Engineering Management Foundations Certificate consists of four (4) graduate courses and is offered on campus or 100% online.

Plan Requirements

Code	Title	Hours	Counts towards
Leadership & Communication Course		**3**	
Select one of the following courses:			
EGR 501	Engineering Leadership and Strategic Change		
COM 530	Interpersonal Communication in Science and Technology Organizations		
COM 527	Seminar in Organizational Conflict Management		
COM 556	Seminar In Organizational Communication		
Financial Competency Course		**3**	
Select one of the following courses:			
ISE 510	Applied Engineering Economy		
EGR 505	Managerial Finance for Engineers		
CE 567	Risk and Financial Management in Construction		
Project Management & Coordination Course		**3**	
Select one of the following courses:			
ISE 754	Logistics Engineering		
BUS 554	Project Management		
CE 561	Construction Project Management		
Quantitative Literacy / Student Choice		**3**	
Select one of the following courses:			
ISE/OR 501	Introduction to Operations Research		
ISE 535	Python Programming for Industrial & Systems Engineers		
ISE 537	Statistical Models for Systems Analytics in Industrial Engineering		
MBA 545	Decision Making under Uncertainty		
ST 515	Experimental Statistics for Engineers I		
ST 513	Statistics for Management and Social Sciences I		

ST 517	Applied Statistical Methods I	
TE 533	Lean Six Sigma Quality	
CE/EGR 590	Special Topics In Civil Engineering (Intro into Facilities Engineering)	
EGR 590	Special Topics in Engineering (Environmental Compliance for Facilities Engineers)	
Any 500-level course from the Master of Engineering Management (MEM) curriculum approved in conjunction with the academic committee		
Total Hours		**12**

Faculty

Full Professors

Julie Ivy

Practice/Research/Teaching Professors

Brandon M. McConnell

Environmental Engineering

Graduate programs are offered in coastal and water resources engineering, computing and systems, construction engineering and management, environmental engineering, geotechnical and geoenvironmental engineering, mechanics and materials, structural engineering and mechanics, transportation engineering and materials.

Admission Requirements

Normal minimum GPA requirements include 3.0 overall and in the major. Students who do not meet these academic requirements may take graduate courses through the Non Degree Studies program to demonstrate academic ability, but consultation with the Director of Graduate Programs is strongly advised. Applicants without academic experience in civil engineering, construction engineering, or environmental engineering may be required to take undergraduate courses to remove deficiencies, but graduate credit is not given for these courses. The Graduate Record Examination is required for all international applicants and all applicants to the MSCE or MSENE degree programs.

Master's Degree Requirements

Four Master's degrees, requiring a minimum of 30 or 31 credit hours, are available. At least two-thirds of a Master's program should be in a well-defined major area of concentration. The MCE is a non-thesis (Option B) degree with other requirements, such as independent projects or core courses, specified in some areas of specialization. A formal minor is not permitted. The MCE is available both on-campus and through distance education. The MSCE degree requires a thesis and a formal minor is optional. Requirements for the MENE and MSENE are the similar to those for the CE degrees.

Doctoral Degree Requirements

The Ph.D. typically requires one year of full-time course work beyond the master's degree and research culminating in a dissertation. The program must develop a well-defined major area of concentration and may include supporting courses outside the major or a formal minor in a related field. All specialty areas, including Environmental Engineering, are included in the one Ph.D. program.

Student Financial Support

Departmental teaching and research assistantships are available including coverage of tuition and health insurance. Fellowships -- full or supplemental to an assistantship -- are available for exceptional applicants. All financial aid recipients are selected on merit-based competition with other applicants. Applications requesting financial aid (both U.S. and international) should be submitted early: December 15 for Fall admission and by July 15 for Spring admission.

Degrees

- Environmental Engineering (MR) (p. 503)
- Environmental Engineering (MS) (p. 513)

Full Professors

Sankarasubramanian Arumugam

Morton A. Barlaz

Emily Zechman Berglund

Joseph F. DeCarolis
Area of Research: Environmental Engineering & Energy Policy

Francis Lajara De Los Reyes III

Joel Ducoste

Henry C. Frey

Mohammed Awad Gabr

Detlef R. Knappe

Gnanamanikam Mahinthakumar

Margery Frances Overton

Ranji Ranjithan

Associate Professors

Douglas F. Call
Area of Research: Environmental Engineering & Water Resources

Joel Casey Dietrich

Andrew P. Grieshop

Brina Mortensen Montoya

Daniel R. Obenour
Area of Research: Environmental & Coastal Engineering

Benjamin Shane Underwood

Assistant Professors

Katherine Anarde

Tarek Aziz

Fernando Garcia Menendez

Angela Rose Harris

Jordan Kern

Practice/Research/Teaching Professors

Florentino Banaag De La Cruz

Meagan Kittle Autry

James William Levis

Gregory W. Lucier

Elizabeth J. Sciaudone

Emeritus Faculty

Robert C. Borden

Earl Downey Brill Jr.

Adjunct Faculty

Michael Scott Breen

Anderson Rodrigo de Queiroz

Daniel J. Findley

Alejandra C. Geiger-Ortiz

Environmental Engineering (MR)

Master of Environmental Engineering Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area:

- Air Pollution Engineering Specialization (p. 503)
- Engineering: Coastal Engineering Specialization (p. 504)
- Energy Systems Analysis Specialization (p. 505)
- Environmental Process Engineering Specialization (p. 506)
- Environmental, Water Resources, and Coastal Engineering Specialization (p. 506)
- Modeling and Systems Analysis Specialization (p. 507)
- Water Resources Engineering Specialization (p. 508)

Degrees earned will be distributed as: "Master of Environmental Engineering" without specialization specifications.

Air Pollution Engineering Specialization

Code	Title	Hours	Counts towards
Core Courses			
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 579	Principles of Air Quality Engineering	3	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 779	Advanced Air Quality	3	
Core Electives			
Technical Electives			
Total Hours		**12**	

Core Electives

Code	Title	Hours	Counts towards
CE 596	Special Topics in Water Resource and Environmental Engineering (Energy and Climate)	3	
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 776	Advanced Water Management Systems	3	
CHE 575	Advances in Pollution Prevention: Environmental Management for the Future	3	
MEA 510	Air Pollution Meteorology	3	
MEA 580	Air Quality Modeling and Forecasting	4	
MEA 703	Atmospheric Aerosols	3	
MEA 710	Atmospheric Dispersion	3	

Technical Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 538	Information Technology and Modeling	3	
CE 571	Physical Principles of Environmental Engineering	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
GIS 510	Fundamentals of Geospatial Information Science and Technology	3	
MAE 406	Energy Conservation in Industry	3	
MAE 408	Internal Combustion Engine Fundamentals	3	
MAE 412	Design of Thermal System	3	
PA 550	Environmental Policy	3	
ST 515	Experimental Statistics for Engineers I	3	
ST 516	Experimental Statistics For Engineers II	3	

Engineering: Coastal Engineering Specialization

Code	Title	Hours	Counts towards
Typical Course Selections			
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Structures)	1-6	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
MEA 540	Principles of Physical Oceanography	3	
MEA 562	Marine Sediment Transport	3	
MEA/GIS 582	Geospatial Modeling	3	
MEA 792	Advanced Special Topics in Earth Sciences (Advanced Geospatial Modeling with Open Source GIS)	3	
MA 501	Advanced Mathematics for Engineers and Scientists I	3	
MA 534	Introduction To Partial Differential Equations	3	
ST 515	Experimental Statistics for Engineers I	3	
ST 730	Applied Time Series Analysis	3	

Energy Systems Analysis Specialization

Code	Title	Hours	Counts towards
Suggested Core Courses			
CE 537	Computer Methods and Applications	3	
CE 578	Energy and Climate	3	
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Energy Modeling)	1-3	
Core Electives			
Technical Electives			
Total Hours		**10-12**	

Core Electives

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 579	Principles of Air Quality Engineering	3	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computer Modeling)	1-3	
ECG 515	Environmental and Resource Policy	3	

Technical Electives

Code	Title	Hours	Counts towards
Suggested Technical Electives			
CE 776	Advanced Water Management Systems	3	
CE 779	Advanced Air Quality	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Environmental Life-Cycle Analysis)	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Hydroclimatology	3	
ECE 550	Power System Operation and Control	3	
ISE 510	Applied Engineering Economy	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
ISE 712	Bayesian Decision Analysis For Engineers and Managers	3	
ISE 731	Multi-Attribute Decision Analysis	3	
OR 501	Introduction to Operations Research	3	
OR 504	Introduction to Mathematical Programming	3	
OR 505	Linear Programming	3	
PA 511	Public Policy Analysis	3	
PA 550	Environmental Policy	3	

Environmental Process Engineering Specialization

Code	Title	Hours	Counts towards
Core Courses			
CE 571	Physical Principles of Environmental Engineering	3	
CE 573	Biological Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
Core Electives			
Technical Electives			
Total Hours		**9**	

Core Electives

Code	Title	Hours	Counts towards
CE 537	Computer Methods and Applications	3	
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
CE 584	Hydraulics Of Ground Water	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Water and Sanitation for Developing Countries)	1-6	
CE 771	Physical-Chemical Water Treatment Processes	3	
CE 774	Environmental Bioprocess Technology	3	
CE 775	Modeling and Analysis Of Environmental Systems	3	

Technical Electives

Code	Title	Hours	Counts towards
Suggested Technical Electives			
CE 596	Special Topics in Water Resource and Environmental Engineering	1-6	
CE 772	Environmental Exposure and Risk Analysis	3	
CHE 546	Design and Analysis of Chemical Reactors	3	
CHE 575	Advances in Pollution Prevention: Environmental Management for the Future	3	
MAE 560	Computational Fluid Mechanics and Heat Transfer	3	
MEA 579	Principles of Air Quality Engineering	3	
PA 550	Environmental Policy	3	
SSC 521	Soil Chemistry	3	
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	

Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
Required Course			
CE 607	Water Resource and Environmental Engineering Seminar	1	
Total Hours		**1**	

Modeling and Systems Analysis Specialization

Code	Title	Hours	Counts towards
Core Courses			
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 776	Advanced Water Management Systems	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	1-3	
Core Electives			
Technical Electives			
Total Hours		**7-9**	

Core Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 737	Computer-Aided Engineering Systems	3	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 791	Advanced Topics in Civil Engineering Computing (Evolutionary Computation)	1-3	
CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computer Modeling)	1-3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)	1-3	

Technical Electives

Code	Title	Hours	Counts towards
CE 538	Information Technology and Modeling	3	
CE 573	Biological Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
CE 579	Principles of Air Quality Engineering	3	
CE 582	Coastal Hydrodynamics	3	
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	

CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6
CE 596	Special Topics in Water Resource and Environmental Engineering (Energy and Climate)	1-6
CE 784	Ground Water Contaminant Transport	3
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Hydroclimatology	1-3
ECG 515	Environmental and Resource Policy	3
ECG 715	Environmental and Resource Economics	3
ECG 716	Topics In Environmental and Resource Economics	3
FOR 734	Advanced Forest Management Planning	3
OR 501	Introduction to Operations Research	3
OR 504	Introduction to Mathematical Programming	3
OR 505	Linear Programming	3
OR 506	Algorithmic Methods in Nonlinear Programming	3
OR 565	Graph Theory	3
OR 706	Nonlinear Programming	3
OR 708	Integer Programming	3
OR 709	Dynamic Programming	3
ST 515	Experimental Statistics for Engineers I	3
PA 550	Environmental Policy	3
MEA/GIS 582	Geospatial Modeling	3

Water Resources Engineering Specialization

Code	Title	Hours	Counts towards
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
Core Electives			
Technical Electives			
Total Hours		**10-15**	

Core Electives

Code	Title	Hours	Counts towards
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 776	Advanced Water Management Systems	3	
CE 784	Ground Water Contaminant Transport	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	1-3	

CE 796	Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)	1-3

Technical Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 571	Physical Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	
BAE 573	Introduction to Hydrologic and Water Quality Modeling	3	
BAE 574	DRAINMOD: Theory and Application	3	
BAE 575	Design of Structural Stormwater Best Management Practices	3	
BAE 576	Watershed Monitoring and Assessment	3	
BAE 581	Open Channel Hydraulics for Natural Systems	3	
BAE 584	Introduction to Fluvial Geomorphology	3	
BAE/SSC 771	Theory Of Drainage--Saturated Flow	3	
FOR 784	The Practice Of Environmental Impact Assessment	4	
MEA 540	Principles of Physical Oceanography	3	
MEA/GIS 582	Geospatial Modeling	3	
MEA 700	Environmental Fluid Mechanics	3	
NR 500	Natural Resource Management	4	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

CCEE Department ABM Admission

The CCEE department encourages excellent undergraduate students to obtain a master's degree in their chosen field of specialization within 2 to 3 semesters past BS graduation, through double counting up to 9 credit hours towards both bachelor's and master's degrees. This is referred to as the Accelerated Bachelor's/Master's (ABM) degree program. Following is the pathway for the ABM program.

Step 1 – Verify your eligibility for applying to the ABM program

- You must have completed at least 75 credit hours (this typically means junior standing)
  - If you are a transfer student, you must have completed at least two semesters at NCSU, earning a minimum of 24 credit hours
- You must not have already received a BS degree
- You must have an overall GPA # 3.5 and major GPA # 3.25

Step 2 – Apply for ABM by following the steps below

- Determine your area of interest from the list of graduate specialty areas on the next page.
- Talk to the ABM advisor in the specialty area (provided below), and agree on a tentative ABM Plan of Work (POW) that would suit your

interests and satisfy the ABM requirements. A finalized ABM POW must be in place before completion of the BS degree.

- Submit an application at go.ncsu.edu/ccee-abm (https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56), which includes the tentative ABM POW.
  - The application will first be reviewed by the ABM advisor and a recommendation will be made to the department. The final determination will be made after a joint review by the directors of undergraduate and graduate programs, after which you will be notified.

Step 3 – While in the ABM program, maintain status by following the steps below:

- With the specialty area ABM advisor's help, prepare a tentative Graduate POW, that complements the Undergraduate POW.
  - Up to 9 credit hours can be double counted, they must be at the 500 level, and they must be selected from the approved list of courses in the specialty area (provided in the subsequent pages).
  - The (tentative) Graduate POW must be formally approved by the ABM advisor.
- It is your responsibility to ensure that both the Graduate POW and Undergraduate POW satisfy the respective master's and undergraduate degree requirements
- You must maintain an overall GPA # 3.5 and a major GPA # 3.25 until you enter the master's program.
- Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master's degree.
- Towards the end of your bachelor's program, you must formally apply to the master's program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a completed and signed ABM Plan of Work (https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf).
- You must complete the master's degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master's student needing to take the full 30/31 graduate credits solely towards your master's degree.

Graduate Specialty Areas for ABM

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

Allowable Courses by Specialty Area

COMPUTING SYSTEMS

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 590	Special Topics In Civil Engineering (Civil Engineering Systems)		

CONSTRUCTION ENGINEERING

Code	Title	Hours	Counts towards
CE 561	Construction Project Management		
CE 562	Lean Construction Concepts and Methods		
CE 564	Legal Aspects of Contracting		
CE 565	Construction Safety Management		
CE 567	Risk and Financial Management in Construction		
CE 592	Special Topics in Construction Engineering		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		

CE 548	Engineering Properties Of Soils I		

EWC – AIR

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control *		
CE 578	Energy and Climate *		
CE 579	Principles of Air Quality Engineering *		

EWC – ENVIRONMENTAL PROCESS ENGINEERING

Code	Title	Hours	Counts towards
CE 571	Physical Principles of Environmental Engineering		
CE 573	Biological Principles of Environmental Engineering		
CE 574	Chemical Principles of Environmental Engineering		
CE 577	Engineering Principles Of Solid Waste Management *		
CE 578	Energy and Climate *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Global Sanitation) *		

EWC – WATER RESOURCES, COASTAL

Code	Title	Hours	Counts towards
CE 581	Fluid Mechanics in Natural Environments		
CE 583	Engineering Aspects Of Coastal Processes		
CE 584	Hydraulics Of Ground Water		
CE 586	Engineering Hydrology		
CE 588	Water Resources Engineering *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)		
CE 596	Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)		

GEOTECHNICAL ENGINEERING

Code	Title	Hours	Counts towards
CE 548	Engineering Properties Of Soils I		
CE 584	Hydraulics Of Ground Water		
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 526	Finite Element Method in Structural Engineering		
CE 577	Engineering Principles Of Solid Waste Management		

STRUCTURAL ENGINEERING AND MECHANICS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		

CE 522	Theory and Design Of Prestressed Concrete
CE 523	Theory and Behavior Of Steel Structures
CE 524	Analysis and Design Of Masonry Structures
CE 525	Advanced Structural Analysis
CE 526	Finite Element Method in Structural Engineering
CE 527	Structural Dynamics
CE 528	Structural Design in Wood
CE 529	FRP Strengthening and Repair of Concrete Structures
CE 530	Properties of Concrete and Advanced Cement-Based Composites

TRANSPORTATION MATERIALS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 530	Properties of Concrete and Advanced Cement-Based Composites		
CE 548	Engineering Properties Of Soils I		
CE 595	Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)		

TRANSPORTATION SYSTEMS

Code	Title	Hours	Counts towards
CE 501	Transportation Systems Engineering *		
CE 502	Traffic Operations *		
CE 503	Highway Design *		
CE 504	Airport Planning and Design		
CE 505	Railroad System Planning, Design, and Operation		
CE 509	Highway Safety		

* This course is not a prerequisite but recommended to be completed prior to enrollment.

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Adjunct Faculty

Michael Scott Breen

Anderson Rodrigo de Queiroz

Daniel J. Findley

Alejandra C. Geiger-Ortiz

Environmental Engineering (MS)

Master of Science Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science" without specialization specifications.

Environmental, Water Resources, and Coastal Engineering Specialization

Code	Title	Hours	Counts towards
Required Courses			
CE 607	Water Resource and Environmental Engineering Seminar	1	
CE 695	Master's Thesis Research	1-6	
Total Hours		**2-7**	

Water Resources Engineering Specialization

Code	Title	Hours	Counts towards
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
Core Electives			
Technical Electives			
Total Hours		**10-15**	

Core Electives

Code	Title	Hours	Counts towards
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 776	Advanced Water Management Systems	3	
CE 784	Ground Water Contaminant Transport	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	1-3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)	1-3	

Technical Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 571	Physical Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	
BAE 573	Introduction to Hydrologic and Water Quality Modeling	3	
BAE 574	DRAINMOD: Theory and Application	3	
BAE 575	Design of Structural Stormwater Best Management Practices	3	
BAE 576	Watershed Monitoring and Assessment	3	
BAE 581	Open Channel Hydraulics for Natural Systems	3	
BAE 584	Introduction to Fluvial Geomorphology	3	
BAE/SSC 771	Theory Of Drainage--Saturated Flow	3	
FOR 784	The Practice Of Environmental Impact Assessment	4	
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MEA 700	Environmental Fluid Mechanics	3	
NR 500	Natural Resource Management	4	

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- Submit an application at go.ncsu.edu/ccee-abm (https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56), which includes the tentative ABM POW.
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- You must maintain an overall GPA # 3.5 and a major GPA # 3.25 until you enter the master's program.
- Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master's degree.
- Towards the end of your bachelor's program, you must formally apply to the master's program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a completed and signed ABM Plan of Work (https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf).
- You must complete the master's degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master's student needing to take the full 30/31 graduate credits solely towards your master's degree.

Graduate Specialty Areas for ABM

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

Allowable Courses by Specialty Area

COMPUTING SYSTEMS

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers		
CE 537	Computer Methods and Applications		
CE 538	Information Technology and Modeling		
CE 590	Special Topics In Civil Engineering (Civil Engineering Systems)		

CONSTRUCTION ENGINEERING

Code	Title	Hours	Counts towards
CE 561	Construction Project Management		
CE 562	Lean Construction Concepts and Methods		
CE 564	Legal Aspects of Contracting		
CE 565	Construction Safety Management		
CE 567	Risk and Financial Management in Construction		
CE 592	Special Topics in Construction Engineering		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 548	Engineering Properties Of Soils I		

EWC – AIR

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control *		
CE 578	Energy and Climate *		
CE 579	Principles of Air Quality Engineering *		

EWC – ENVIRONMENTAL PROCESS ENGINEERING

Code	Title	Hours	Counts towards
CE 571	Physical Principles of Environmental Engineering		
CE 573	Biological Principles of Environmental Engineering		
CE 574	Chemical Principles of Environmental Engineering		
CE 577	Engineering Principles Of Solid Waste Management *		
CE 578	Energy and Climate *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Global Sanitation) *		

EWC – WATER RESOURCES, COASTAL

Code	Title	Hours	Counts towards
CE 581	Fluid Mechanics in Natural Environments		
CE 583	Engineering Aspects Of Coastal Processes		
CE 584	Hydraulics Of Ground Water		
CE 586	Engineering Hydrology		
CE 588	Water Resources Engineering *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *		
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)		
CE 596	Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)		

GEOTECHNICAL ENGINEERING

Code	Title	Hours	Counts towards
CE 548	Engineering Properties Of Soils I		
CE 584	Hydraulics Of Ground Water		
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)		
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:			
CE 515	Advanced Strength of Materials		
CE 526	Finite Element Method in Structural Engineering		
CE 577	Engineering Principles Of Solid Waste Management		

STRUCTURAL ENGINEERING AND MECHANICS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		

CE 523	Theory and Behavior Of Steel Structures
CE 524	Analysis and Design Of Masonry Structures
CE 525	Advanced Structural Analysis
CE 526	Finite Element Method in Structural Engineering
CE 527	Structural Dynamics
CE 528	Structural Design in Wood
CE 529	FRP Strengthening and Repair of Concrete Structures
CE 530	Properties of Concrete and Advanced Cement-Based Composites

TRANSPORTATION MATERIALS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials		
CE 530	Properties of Concrete and Advanced Cement-Based Composites		
CE 548	Engineering Properties Of Soils I		
CE 595	Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)		

TRANSPORTATION SYSTEMS

Code	Title	Hours	Counts towards
CE 501	Transportation Systems Engineering *		
CE 502	Traffic Operations *		
CE 503	Highway Design *		
CE 504	Airport Planning and Design		
CE 505	Railroad System Planning, Design, and Operation		
CE 509	Highway Safety		

* This course is not a prerequisite but recommended to be completed prior to enrollment.

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Anderson Rodrigo de Queiroz

Daniel J. Findley

Alejandra C. Geiger-Ortiz

Industrial Engineering

The graduate faculty of the Edward P. Fitts Department of Industrial and Systems Engineering supports academic and research interests in four areas:

1. manufacturing systems (manufacturing processes, medical device manufacturing systems, CAM, CIM, robotics, automation, rapid prototyping and concurrent engineering);
2. production systems (logistics systems, supply chain management, scheduling, inventory control, materials handling, facility design, furniture manufacturing and management, quality control, and engineering economics);
3. systems analysis and optimization (health systems, stochastic processes, simulation, mathematical programming, and soft computing); and
4. ergonomics (human performance, occupational safety, and biomechanics). The department faculty actively supports independent graduate degree programs in operations research, integrated manufacturing systems engineering, textile technology and management, and financial mathematics.

Admission Requirements

Applications are accepted from undergraduate majors in engineering and in the behavioral, physical and mathematical sciences who meet prerequisites in calculus and linear algebra, computer science, and statistics.

Master's Degree Requirements

The M.S. degree requires 30 credit hours and involves depth of study in a specified area of concentration, nine hours in a minor, and six hours of research credit. The Master of Industrial Engineering (M.IE.) degree may be obtained by course work only; project work is optional. A minimum of 33 credit hours is required for the M.IE.

Doctoral Degree Requirements

This degree requires 72 credit hours of course and research work beyond the Bachelor's degree. Undergraduate students with superior credentials may apply directly to the doctoral program and bypass the master's degree. For students who have completed the Master's degree, typically 30 to 36 hours of additional course work are required. A departmental written qualifying examination is required.

Student Financial Support

Research and teaching assistantships are available on a competitive basis to early applicants. Fellowships that supplement assistantship stipends are available to U.S. applicants with superior credentials. Award priority is given to Ph.D. and then to M.S. applicants.

Degrees

- Industrial Engineering (MR) (p. 519)
- Industrial Engineering (MS) (p. 521)
- Industrial Engineering (PhD) (p. 523)
- Industrial Engineering (Minor) (p. 525)

Faculty

Full Professors

Paul Cohen

Shu-Cherng Fang

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Ola Lars Anders Harrysson

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Industrial Engineering (MR)

Master of Industrial Engineering Degree Requirements

Code	Title	Hours	Counts towards
Required Course		**1**	
ISE 601	Seminar		
Breadth Requirement Courses		**15**	
See "Breadth Requirement Courses" listed below			
Technical Elective Courses		**9**	
"Technical Elective Courses" will be determined in conjunction with the academic committee			
Additional Technical Elective Courses		**6**	
"Additional Technical Elective Courses" are approved in conjunction with the academic committee			
Total Hours		**31**	

Breadth Requirement Courses

Code	Title	Hours	Counts towards
Select a minimum of one course from at least four of the following breadth requirement groups:		**12**	
Group A : Economic & Decision Analysis			
ISE 510	Applied Engineering Economy		
ISE 711	Capital Investment Economic Analysis		
ISE 712	Bayesian Decision Analysis For Engineers and Managers		
ISE 731	Multi-Attribute Decision Analysis		
Group B: Human Factors and Ergonomics Category			
ISE 540	Human Factors In Systems Design		
ISE 541	Occupational Safety Engrg		
ISE 544	Occupational Biomechanics		
ISE 744	Human Information Processing		

ISE 745	Human Performance Modeling	
Group C: Manufacturing Systems Category		
ISE 515	Manufacturing Process Engineering	
ISE 714	Product Manufacturing Engineering for the Medical Device Industry	
ISE 716	Automated Systems Engineering	
ISE 519	Database Applications in Industrial and Systems Engineering	
Group D: Production Systems Category		
ISE 552	Design and Control of Production and Service Systems	
ISE 723	Production Planning, Scheduling and Inventory Control	
ISE 726	Theory of Activity Networks	
ISE 748	Quality Engineering	
ISE 754	Logistics Engineering	
Group E: Systems Analytics and Optimization Category		
ISE 501	Introduction to Operations Research	
OR 504	Introduction to Mathematical Programming	
ISE 505	Linear Programming	
ISE 560	Stochastic Models in Industrial Engineering	
ISE 562	Simulation Modeling	
ISE 709	Dynamic Programming	
ISE 760	Applied Stochastic Models in Industrial Engineering	
ISE 761	Queues and Stochastic Service Systems	
ISE 762	Computer Simulation Techniques	
Select one course from the following:		**3**
Group F: Computer Science, Mathematics, and Statistics		
CSC 513	Electronic Commerce Technology	
CSC 520	Artificial Intelligence I	
CSC 570	Computer Networks	
CSC 742	Advanced Topics in Database Management Systems	
MA 520	Linear Algebra	
MA 580		
ST 516	Experimental Statistics For Engineers II	
ST 711	Design Of Experiments	
Total Hours		**15**

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Industrial Engineering (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Required Course		**10**	
ISE 601	Seminar		
ISE 695	Master's Thesis Research		
Select one 700-level ISE course approved in conjunction with the academic committee			
Breadth Requirement Courses		**12**	
See "Breadth Requirement Courses" listed below			
Minor Courses		**9**	
"Minor Courses" will be determined in conjunction with the academic committee			
Total Hours		**31**	

Breadth Requirements

Code	Title	Hours	Counts towards
Select a minimum of one course from at least three of the following groups:		**9**	
Group A : Economic & Decision Analysis			
ISE 510	Applied Engineering Economy		
ISE 711	Capital Investment Economic Analysis		

ISE 712	Bayesian Decision Analysis For Engineers and Managers	
ISE 731	Multi-Attribute Decision Analysis	
Group B: Human Factors and Ergonomics Category		
ISE 540	Human Factors In Systems Design	
ISE 541	Occupational Safety Engrg	
ISE 544	Occupational Biomechanics	
ISE 744	Human Information Processing	
ISE 745	Human Performance Modeling	
Group C: Manufacturing Systems Category		
ISE 515	Manufacturing Process Engineering	
ISE 714	Product Manufacturing Engineering for the Medical Device Industry	
ISE 716	Automated Systems Engineering	
ISE 519	Database Applications in Industrial and Systems Engineering	
Group D: Production Systems Category		
ISE 552	Design and Control of Production and Service Systems	
ISE 723	Production Planning, Scheduling and Inventory Control	
ISE 726	Theory of Activity Networks	
ISE 748	Quality Engineering	
ISE 754	Logistics Engineering	
Group E: Systems Analytics and Optimization Category		
ISE 501	Introduction to Operations Research	
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ISE 709	Dynamic Programming	
ISE 760	Applied Stochastic Models in Industrial Engineering	
ISE 761	Queues and Stochastic Service Systems	
ISE 762	Computer Simulation Techniques	
Select one course from the following:		**3**
Group F: Computer Science, Mathematics, and Statistics		
CSC 513	Electronic Commerce Technology	
CSC 520	Artificial Intelligence I	
CSC 570	Computer Networks	
CSC 742	Advanced Topics in Database Management Systems	
MA 520	Linear Algebra	
MA 580		
ST 516	Experimental Statistics For Engineers II	
ST 711	Design Of Experiments	
Total Hours		**12**

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Industrial Engineering (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Course		**19**	
ISE 801	Seminar		
Select a minimum of two 700-level ISE course approved in conjunction with the academic committee			
See "Core Courses" listed below			
Elective / Research Courses		**54**	
"Elective / Research Courses" are approved in conjunction with the academic committee			
Total Hours		**73**	

Core Courses

Code	Title	Hours	Counts towards
Select a minimum of one course from each category:		**9**	
Human Factors and Ergonomics Category			
ISE 540	Human Factors In Systems Design		
ISE 541	Occupational Safety Engrg		
ISE 544	Occupational Biomechanics		
ISE 744	Human Information Processing		
ISE 745	Human Performance Modeling		
Manufacturing Systems Category			
ISE 515	Manufacturing Process Engineering		
ISE 519	Database Applications in Industrial and Systems Engineering		
ISE 714	Product Manufacturing Engineering for the Medical Device Industry		
ISE 716	Automated Systems Engineering		
Production Systems Category			
ISE 552	Design and Control of Production and Service Systems		
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ISE 726	Theory of Activity Networks		
ISE 748	Quality Engineering		
ISE 754	Logistics Engineering		
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ISE 560	Stochastic Models in Industrial Engineering		
ISE 562	Simulation Modeling		
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ISE 761	Queues and Stochastic Service Systems		
ISE 762	Computer Simulation Techniques		
Total Hours			**9**

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Industrial Engineering (Minor)

Plan Requirements

Master's Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select at least three 500- or 700-level courses approved in conjunction with the academic committee		
Total Hours		**9**	

PhD Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select at least four 500-level or above courses approved in conjunction with the academic committee		
Total Hours		**12**	

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Integrated Manufacturing Systems Engineering

The Integrated Manufacturing Systems Engineering (IMSE) Institute was established in 1984. IMSE provides multidisciplinary graduate-level education and practical training opportunities in the theory and practice of integrated manufacturing systems engineering at the masters level. IMSE focuses on providing a manufacturing presence and a program environment in the College of Engineering where faculty, graduate students and industry can engage cooperatively in multidisciplinary graduate education, basic and applied research, and technology transfer in areas of common interest related to modern manufacturing systems technology. The objective of the IMSE program is to offer students with traditional discipline backgrounds in engineering and the physical sciences an opportunity to broaden their understanding of the multidisciplinary area of manufacturing systems. Core areas of concentration are offered in manufacturing systems, logistics, mechatronics, and advanced manufacturing.

Admission Requirements

Admission to the IMSE master's program requires a B.S. degree from an accredited institution in engineering, physics, mathematics, or computer science. Check with the Institute if your degree is in a field other than these listed.

Master's Degree Requirements

The IMSE program requires a minimum of 27 hours of graduate course work and six hours of research project. The graduate course work includes five required core courses that provide a multidisciplinary overview of subject materials basic to manufacturing systems, logistics, mechatronics, and advanced manufacturing. Specialization is provided in the student's elective courses. The six hours of research project is performed either individually or in teams in areas that compliment and reinforce the graduate course work.

The IMSE degree is now available through Engineering Online as a distance program. Application to the IMSE Distance Education program is the same as the on-campus program.

Student Financial Support

Assistantships and internships are available to qualified students. The full financial support package covers tuition and health insurance. Internships are also undertaken directly with host companies.

Internship

The IMSE internship program was established to provide a cooperative industrial and academic experience for some IMSE students and our industrial sponsors. Several Internship awards are made available every year for special training in IMSE host companies. Students who are selected to participate in the internship program may receive financial support for up to four semesters and one summer. Typically, the student attends classes for two semesters (fall and spring), works at the sponsor company for the following summer and fall semester, and completes the IMSE course requirements the following spring semester. The student uses the experience at the sponsor company as the basis for their IMSE research project.

Other Relevant Information

IMSE Students are supported by companies across the country during their internships. Both full-time and part-time internship support is provided depending on availability. These companies have included: ABB, ABCO Automation, Applied Materials, AT&T, Bayer, BSH, Bosch, Biogen, Castle Hill Technologies, Caterpillar, Closure Medical, Corning Cable Systems, CSX, Cummins, Disney, Dupont, Daimler Trucks, Elkay, Ford, GE, GKN, GSK, IBM, Ingersoll Rand, Intel, John Deere, Mack Trucks, Mayne Pharma, Michelin, Morganite, MTS Systems,

Nekton Technologies, Rubbermaid, RxMedic, Samsung Semiconductor, Schwanns, Snap-On, Tesla, UPS, Volvo Trucks, and ZF Corporation and many others.

Degrees

- Integrated Manufacturing Systems Engineering (MR) (p. 528)
- Integrated Manufactoring Systems Engineering (Minor) (p. 531)

Full Professors

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Integrated Manufacturing Systems Engineering (MR)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Integrated Manufacturing Systems Engineering" without focus area specifications.

Code	Title	Hours	Counts towards
Core Courses		**15**	
Select one course from each area of the "Focus Area Categories" listed below *			
Elective Courses			
"Elective Courses" will be determined in conjunction with the academic committee		12	
Project Course		**6**	
IMS 675	Manufacturing Systems Engineering Project		
Total Hours		**33**	

Focus Area Categories

Manufacturing

Code	Title	Hours	Counts towards
Select one course from each area below:			
Area 1			
CSC 510	Software Engineering	3	
ISE 562	Simulation Modeling	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
Area 2			
ISE 510	Applied Engineering Economy	3	
BUS 501	Strategic Management Foundations	3	
Area 3			
ISE 707	Real-Time Control of Automated Manufacturing	3	
ISE 515	Manufacturing Process Engineering	3	
ISE 716	Automated Systems Engineering	3	
Area 4			
ISE 552	Design and Control of Production and Service Systems	3	
ISE 723	Production Planning, Scheduling and Inventory Control	3	
Area 5			
TE 533	Lean Six Sigma Quality	3	
EGR 590	Special Topics in Engineering	1-6	

Logistics / Supply Chain

Code	Title	Hours	Counts towards
Select one course from each area below:			
Area 1			
CSC 510	Software Engineering	3	
ISE 562	Simulation Modeling	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
Area 2			
ISE 510	Applied Engineering Economy	3	

BUS 501	Strategic Management Foundations	3
Area 3		
MBA 541	Supply Management	3
MBA 542	Supply Chain Logistics	3
Area 4		
ISE 552	Design and Control of Production and Service Systems	3
ISE 723	Production Planning, Scheduling and Inventory Control	3
Area 5		
MBA 549	Supply Chain Management Practicum	3
ISE 754	Logistics Engineering	3

Mechatronics

Code	Title	Hours	Counts towards
Select one course from each area below:			
Area 1			
ECE 556	Mechatronics	3	
MAE 536	Micro/Nano Electromechanical Systems	3	
Area 2			
MAE 531	Engineering Design Optimization	3	
MAE/ECE 535	Design of Electromechanical Systems	3	
Area 3			
ECE 511	Analog Electronics	3	
ECE 555	Autonomous Robot Systems	3	
Area 4			
CSC/ECE 517	Object-Oriented Design and Development	3	
ECE 561	Embedded System Design	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
Area 5			
ECE 516	System Control Engineering	3	
ISE 707	Real-Time Control of Automated Manufacturing	3	
ISE 716	Automated Systems Engineering	3	

Advanced Manufacturing

Code	Title	Hours	Counts towards
Select one course from each area below:			
Area 1			
ISE 589	Special Topics In Industrial Engineering	1-6	
Area 2			
BUS 501	Strategic Management Foundations	3	
ISE 510	Applied Engineering Economy	3	
Area 3			
MAE 545	Metrology For Precision Manufacturing	3	
MSE 500	Modern Concepts in Materials Science	3	
Area 4			
ECE 555	Autonomous Robot Systems	3	
ISE 589	Special Topics In Industrial Engineering	1-6	
MAE 535	Design of Electromechanical Systems	3	
Area 5			
ISE 589	Special Topics In Industrial Engineering	1-6	
MAE 531	Engineering Design Optimization	3	

* Core course substitutions are allow with permission of the IMSE DGP.

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Integrated Manufactoring Systems Engineering (Minor)

Plan Requirements

Master's Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select at least three 500- or 700-level courses approved in conjunction with the academic committee		
Total Hours		**9**	

PhD Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select at least four 500-level or above courses approved in conjunction with the academic committee		
Total Hours		**12**	

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Materials Science & Engineering

Materials enable all of the engineering and high-technology fields that are an integral part of our society. Graduate programs in this department focus on understanding the structure, structure modification and properties of materials and the development of new or improved materials and advanced processing methods that are critical links between the design and the realization of new systems for manufacturing, nanotechnology, energy, and biomaterials.

The M.S. and Ph.D. programs are research-based degree programs focusing on faculty-mentored, state-of-the-art materials research that leads to a thesis or dissertation.

The Master of Materials Science and Engineering is a non-thesis degree program designed for students from a variety of technical backgrounds interested in furthering their understanding of materials processing, characterization and properties. This program is appropriate for distance-education Masters students.

The Master of Nanoengineering is a multidisciplinary non-thesis degree program designed so students can declare a concentration in one of the following three areas:

1. Materials Science in Nanoengineering;
2. Nanoelectronics and Nanophotonics; or
3. Biomedical Sciences in Nanoengineering.

This program is appropriate for distance-education Masters students.

Admission Requirements

In addition to the general admission requirements as set by the Graduate School, the department requires submission of GRE scores. Non-native English speakers also require a minimum TOEFL score as established by the Graduate School.

Master's Degrees Requirements

The Master of Science degree (M.S.) requires 30 credit hours of coursework/research and a research thesis. The Master of Materials Science and Engineering degree (M.M.S.E.) requires 30 credit hours of coursework only. The Master of Nanoengineering (M.NAE.) requires 30 credit hours of coursework only.

Doctoral Degree Requirements

The doctoral degree (Ph.D.) requires 72 credit hours of coursework/research, a qualifying exam, and a research dissertation.

Student Financial Support

Students in the M.S. and Ph.D. graduate programs normally receive financial support in the form of research or teaching assistantships or fellowships.

Other Relevant Information

The department reflects the interdisciplinary nature of the field of Materials Science and Engineering. A substantial number of current graduate students majored in fields other than but related to materials, and the department has associated graduate faculty from other departments supervising thesis and dissertation research.

Degrees

- Materials Science and Engineering (MR) (p. 534)
- Materials Science and Engineering (MS) (p. 536)
- Materials Science and Engineering (PhD) (p. 537)
- Materials Science and Engineering (Minor) (p. 539)
- Materials Informatics (Certificate) (p. 540)
- Materials Science and Engineering (Certificate) (p. 540)

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Materials Science and Engineering (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
	Select a minimum of 18 credit hours of 500- to 700-level MSE courses approved in conjunction with the academic committee		
Additional Courses		**12**	
	"Additional Courses" are approved in conjunction with the academic committee and may come from graduate-level courses in MSE or other technical disciplines		
Total Hours		**30**	

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Accelerated Bachelor's/Master's Degree Requirements

Undergraduate Requirements

The following undergraduate programs meet the undergraduate requirements for the Accelerated Bachelor's / Master's (ABM):

- Materials Science Engineering (http://catalog.ncsu.edu/undergraduate/engineering/materials-science-engineering/materials-science-engineering-bs/#planrequirementstext) (BS) (http://catalog.ncsu.edu/undergraduate/engineering/materials-science-engineering/materials-science-engineering-bs/#planrequirementstext)
- Materials Science Engineering (BS): Biomaterials Concentration (http://catalog.ncsu.edu/undergraduate/engineering/materials-science-engineering/materials-science-engineering-bs-biomaterials-concentration/)
- Materials Science Engineering (BS): Nanomaterials Concentration (http://catalog.ncsu.edu/undergraduate/engineering/materials-science-engineering/materials-science-engineering-bs-nanomaterials-concentration/)

Double-Counted Courses

After taking 12 credit hours of double-counted courses in the BS degree, only 18 hours remain for completion of either master's degree in the fifth year.

Code	Title	Hours	Counts towards
The following courses may be double-counted between the Bachelor's and Master's degrees:			
MSE/NE 409/ MSE 509/NE 509	Nuclear Materials	3	
MSE 440/540	Processing of Metallic Materials	3	
MSE 445/545	Ceramic Processing	3	
MSE 455/555	Polymer Technology and Engineering	3	
MSE 456/556	Composite Materials	3	
MSE 460/560	Microelectronic Materials	3	
MSE 465/565	Introduction to Nanomaterials	3	
MSE 480/580	Materials Forensics and Degradation	3	

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Materials Science and Engineering (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select a minimum of 15 credit hours of 500- to 700-level MSE courses approved in conjunction with the academic committee			
Additional Courses		**9**	
"Additional Courses" are approved in conjunction with the academic committee			
Thesis Course		**6**	
MSE 695	Master's Thesis Research		
Total Hours		**30**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Materials Science and Engineering (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**27**	
Select a minimum of 9 credit hours of 500- to 700-level MSE courses approved in conjunction with the academic committee			
Select a minimum of 18 credit hours of 700-level courses approved in conjunction with the academic committee			
MSE 601	Seminar		
Additional Courses		**45**	
"Additional Courses" are approved in conjunction with the academic committee			
MSE 801	Seminar		
MSE 893	Doctoral Supervised Research		
MSE 885	Doctoral Supervised Teaching		
MSE 895	Doctoral Dissertation Research		
Total Hours		**72**	

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Materials Science and Engineering (Minor)

Plan Requirements

Master's Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
	Select at least three 500- or 700-level MSE courses approved in conjunction with the academic committee		
Total Hours		**9**	

PhD Course Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
	Select at least four 500-level or above MSE courses approved in conjunction with the academic committee		
Total Hours		**12**	

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Materials Informatics (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Course		**3**	
MSE 723	Materials Informatics		
Materials Science Course		**3**	
Select one of the following courses:			
MSE 710	Elements Of Crystallography and Diffraction		
MSE 721	Nanoscale Simulations and Modeling		
MSE 725	Quantitative Materials Characterization Techniques		
Statistics/Mathematics Course		**3**	
ST 517	Applied Statistical Methods I		
ST 533	Applied Spatial Statistics		
MA 540	Uncertainty Quantification for Physical and Biological Models		
Additional Course		**3**	
Additional Course is determined in conjunction with the academic committee [1]			
Total Hours		**12**	

[1] The fourth course will be taken from outside of the student's degree department. For example, an MSE student's fourth course must be from the ST or MA list (above), whereas a ST or MA student's fourth course must be from the MSE list (above).

Materials Science and Engineering (Certificate)

The Graduate Certificate Program (GCP) in Materials Science and Engineering (MSE) is designed for working professionals who do not have formal training in MSE, but wish to acquire a basic understanding of materials science to improve their on-the-job experience and knowledge. Most people will enroll in this program as distance education students through the Engineering Online (EOL) office at NC State University. Students can customize their particular certificate programs to focus on specific areas of materials science that interest them.

Program of Study

The MSE GCP requires a total of 12 credit hours, including MSE 500 (3 credit hours) and three MSE elective courses (9 credit hours) selected by the student. MSE 500 is a fast-paced overview of the field of materials science and engineering and is designed for students who do not have a

formal background in MSE, such as those with BS degrees in chemistry, physics and other fields of engineering. MSE 500 also provides the foundation for more specialized MSE graduate courses.

Each course is 3 credit hours and most courses are offered at least once per year through the EOL office. By judicious selection of elective courses, students can customize their GCP to focus on areas of interest to them.

Admissions Requirements

To be admitted to the MSE Graduate Certificate Program, a student must have a BS degree in the sciences or engineering from a regionally accredited four-year college or university, and have an overall (or major) GPA of at least 3.0 on a 4-point scale.

All new students must complete the NCSU Graduate School application for admission to the MSE GCP. The GRE exam is NOT required for admission to the GCP. Application deadlines are March 1 for summer and fall admission, and October 1 for spring admission. Students can begin study in the fall, spring or summer semester immediately following their acceptance into the program.

Academic success in the MSE GCP might have a strong bearing on admission to a graduate degree program. However, completion of a graduate certificate program IN NO WAY guarantees entry into a graduate degree program, which must be done through a separate application process.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
MSE 500	Modern Concepts in Materials Science		
Select a minimum of three courses from "MSE Courses" listed below			
Total Hours		**12**	

MSE Courses

Code	Title	Hours	Counts towards
Select a minimum of three of the following courses:		**9**	
MSE/NE 509	Nuclear Materials		
MSE 540	Processing of Metallic Materials		
MSE 545	Ceramic Processing		
MSE 555	Polymer Technology and Engineering		
MSE 556	Composite Materials		
MSE 560	Microelectronic Materials Science and Technology		
MSE 561	Organic Chemistry Of Polymers		
MSE 565	Introduction to Nanomaterials		
MSE 566	Mechanical Properties of Nanostructured Materials		
MSE 576	Technology Entrepreneurship and Commercialization I		
MSE 577	Technology Entrepreneurship and Commercializatior II		
MSE 580	Materials Forensics and Degradation		
MSE 589	Solid State Solar and Thermal Energy Harvesting		
MSE 702	Defects In Solids		
MSE 703	Interaction of Electrons with Materials		
MSE 704	Interaction of Photons with Materials		
MSE 705	Mechanical Behavior Of Engineering Materials		
MSE 706	Phase Transformations and Kinetics		
MSE 708	Thermodynamics Of Materials		
MSE 709	Metastable Materials: Processing, Structure, and Properties		
MSE 710	Elements Of Crystallography and Diffraction		
MSE 712	Scanning Electron Microscopy		
MSE 715	Fundamentals Of Transmission Electron Microscopy		
MSE 718	Advanced Transmission Electron Microscopy		

MSE 721	Nanoscale Simulations and Modeling	
MSE 723	Materials Informatics	
MSE 731	Materials Processing by Deformation	
MSE 741	Principles of Corrosion	
MSE 751	Thin Film and Coating Science and Technology I	
MSE 752	Thin Film and Coating Science and Technology II	
MSE/NE 757	Radiation Effects on Materials	
MSE 760	Materials Science in Processing of Semiconductor Devices	
MSE 761	Polymer Blends and Alloys	
MSE 763	Characterization Of Structure Of Fiber Forming Polymers	
MSE 770	Defects, Diffusion and Ion Implantation In Semiconductors	
MSE 771	Materials Science of Nanoelectronics	
MSE 775	Structure of Semicrystalline Polymers	
MSE 791	Advanced Topics in Materials Science and Engineering	
MSE 795	Advanced Materials Experiments	
Total Hours		**9**

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Mechanical Engineering

The Mechanical Engineering graduate program prepares students in all aspects of mechanical and thermal systems design and manufacturing. Course offerings and research programs for mechanical engineering students are available in applied mechanics; biomechanics; combustion; design and manufacturing: dynamic systems and control; energy conversion and systems; experimental mechanics; fluid dynamics; heat transfer; mechanics of materials; micro, nano and MEMS; and vibration and acoustics. Sub-areas include adaptive and auto adaptive structures, controls and system identification, CFD, energy conversion and renewable energy, materials processing and tribology, mechatronics, precision engineering, and reactive and multiphase flows.

Admission Requirements

An applicant to the master's program must be a graduate of an accredited undergraduate program with a B.S. degree in either mechanical or aerospace engineering. Graduates of other accredited programs in engineering, physical sciences and mathematics may be considered but may be required to make up undergraduate deficiencies without graduate credit. The most qualified applicants are accepted first. Applicants to the Ph.D. program must have met the M.S. admission requirements and additionally must satisfy the Ph.D. admissions requirements. Applicants to the online, distance education M.S. program in mechanical or aerospace engineering are not required to take the GRE exam.

Master's Degree Requirements

The thesis-option M.S. degree program in mechanical engineering requires 21 hours of course credit and nine hours of thesis research. The non-thesis M.S. degree requires 27 hours of course credit and a three credit-hour project and is offered on campus as well as off campus, through distance education.

Ph.D. Degree Requirements

A minimum of 72 hours of credit are required to obtain the Ph.D. degree. A direct path to the Ph.D. from the B.S. is also available with which the student is granted the M.S. degree “enroute” to the Ph.D. The enroute Ph.D. (direct to Ph.D. path) requires a minimum of 3.5 undergraduate GPA.

Student Financial Support

Financial aid is offered to all admitted Ph.D. students.

Degrees

- Mechanical Engineering (MS) (p. 545)
- Mechanical Engineering (PhD) (p. 546)
- Mechanical Engineering (Minor) (p. 548)

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Steven Berg

Mechanical Engineering (MS)

Degree Requirements

Non-Thesis Option

Code	Title	Hours	Counts towards
Required Courses		**27**	
Select a minimum of nine 500-level to 700-level courses approved in conjunction with the academic committee *			
Project Course		**3**	
MAE 586	Project Work In Mechanical and Aerospace Engineering		
Total Hours		**30**	

Thesis Option

Code	Title	Hours	Counts towards
Required Courses		**21**	
Select a minimum of seven 500-level to 700-level courses approved in conjunction with the academic committee *			
Research Course		**9**	
MAE 695	Master's Thesis Research		
Total Hours		**30**	

* "Required Courses" may include up to three non-MAE courses approved by the Director of Graduate Programs.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

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Mark R. Pankow

Jason F. Patrick

Jong Eun Ryu

Pramod K. V. Subbareddy

Jie Yin

Practice/Research/Teaching Professors

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Emeritus Faculty

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Robert T. Nagel

Larry H. Royster

Ronald O. Scattergood

Furman Y. Sorrell Jr.

John S. Strenkowski

Carl F. Zorowski

Lecturer

Steven Berg

Mechanical Engineering (PhD)

Degree Requirement

Code	Title	Hours	Counts towards
Required Courses		**39**	
Select a minimum of thirteen 500-level to 700-level courses [1]			
Minor Courses (Optional)		**9**	
"Minor Courses" are approved in conjunction with the academic committee [2]			
Research Courses		**24**	
MAE 895	Doctoral Dissertation Research		
Total Hours		**72**	

1 "Required Courses" must consist a minimum of two 700-level courses, and may consist of up to five non-MAE courses approved in conjunction with the academic committee.

2 "Minor Courses" are limited to 500-level and 700-level courses only

Additional Requirements

- Students with a previous MS degree from NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 30 credit hours
- Students with a previous MS from outside NCSU:
  - without minor – may transfer up to 18 credit hours
  - with minor – may transfer up to 18 credit hours

Faculty

Full Professors

Gregory D. Buckner

Tarek Echekki

Tasnim Hassan

He Huang

Jack Ray Edwards Jr

Srinath Ekkad

Tiegang Fang

Ashok Gopalarathnam

Richard David Gould

Xiaoning Jiang

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Steven Berg

Mechanical Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Lecturer

Steven Berg

Nanoengineering

The Master of Nanoengineering (MNAE) is an on campus and distance education program and is designed for students with an undergraduate degree in a science or engineering discipline who wish to pursue a graduate degree in nanoengineering. The field of nanoengineering is expected to revolutionize technology and improve quality of life, particularly as related to energy, environment, and health. Students will achieve an understanding of the fundamental advantages in nanoscale materials, devices and systems. It is a 30 credit hour degree program that does not require a thesis, final oral exam or on-campus residency. GRE scores are recommended but not required. NC State has an existing strength in nanostructured materials and devices.

Students can declare a concentration in one of the following three areas:

1. Materials Science in Nanoengineering;
2. Nanoelectronics and Nanophotonics; or
3. Biomedical Sciences in Nanoengineering.

This program is appropriate for distance-education Masters students.

Admission Requirements

In addition to the general admission requirements as set by the Graduate School, the MNAE program requires a BS degree in science or engineering with a minimum GPA or 3.0. Non-native English speakers also require a minimum TOEFL or IELTS scores as established by the Graduate School.

Degree Requirements

The Master of Nanoengineering (MNAE) requires 30 credit hours of coursework only. The 30 credit hours must consist of 12 credit hours of core courses, 12 credit hours in the areas of concentration and 6 credit hours of technical electives.

Other Relevant Information

The Master of Nanoengineering program is an interdisciplinary one that is comprised of courses taught by faculty from six different departments within the College of Engineering.

Degrees

- Nanoengineering (MR) (p. 550)
- Nanoengineering (MR): Biomedical Sciences in Nanoengineering Concentration (p. 551)
- Nanoengineering (MR): Materials Science in Nanoengineering Concentration (p. 552)
- Nanoengineering (MR): Nanoelectronics and Nanophotonics Concentration (p. 553)

Full Professors

Charles M. Balik

Albena Ivanisevic

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Jagdish Narayan

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Assistant Professors

Kaveh Ahadi

Wenpei Gao

Srikanth Patala

Practice/Research/Teaching Professors

Claude Lewis Reynolds Jr.

Emeritus Faculty

Elizabeth Carol Dickey

Nanoengineering (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select four of the following courses:			
MSE 500	Modern Concepts in Materials Science		
MSE 565	Introduction to Nanomaterials		
MSE 791			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems		
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing		
MAE 536	Micro/Nano Electromechanical Systems		

Code	Title	Hours	Counts towards
Technical Electives		**18**	
"Technical Electives" are approved in conjunction with the academic committee *			
Total Hours		**30**	

* "Technical Electives" may be ones in the MNAE program not used to satisfy other degree requirements or other technical courses approved by the Director of Graduate Program, Nanoengineering.

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Career Opportunities

Nanotechnological advancements have impacted every technological sector and ultimately may change aspects of our daily lives.
The development of these new technologies requires innovative nanoengineers who are invested in the fields of electronics, materials, chemical technology, biotechnology and biomedical engineering.
Graduates of the Master of Nanoengineering program are equipped with a solid foundation in nanoscience and nanotechnology necessary for the development of new products and procedures.

Potential careers associated with nanoengineering are as follows.

- Research and development engineer/scientist
- Biomedical engineer
- Materials engineer/scientist
- Bioinformatics

- Chemist
- Process engineer
- Materials analyst
- Professor
- Medical doctor
- PhD student

Nanoengineering (MR): Biomedical Sciences in Nanoengineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select four of the following courses:			
MSE 500	Modern Concepts in Materials Science		
MSE 565	Introduction to Nanomaterials		
MSE 791			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems		
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing		
MAE 536	Micro/Nano Electromechanical Systems		

Code	Title	Hours	Counts towards
Concentration Requirement Courses		**12**	
Select a minimum of four of the following courses:			
BME 590	Special Topics in Biomedical Engineering (Introduction to Nano-biomaterials)		
BME 540	Nanobiotechnolog Processing, Characterization, and Applications		
BME 566	Polymeric Biomaterials Engineering		
CHE 596	Special Topics in Chemical Engineering (Colloid Science and Nanoscale Engineering)		
CHE 596	Special Topics in Chemical Engineering (Drug Delivery)		
ECE 542	Neural Networks		
ECE/BME 518	Wearable Biosensors and Microsystems		
Technical Electives		**6**	
"Technical Electives" are approved in conjunction with the academic committee *			
Total Hours		**30**	

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- Materials engineer/scientist
- Bioinformatics
- Chemist
- Process engineer
- Materials analyst
- Professor
- Medical doctor
- PhD student

Nanoengineering (MR): Materials Science in Nanoengineering Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select four of the following courses:			
MSE 500	Modern Concepts in Materials Science		
MSE 565	Introduction to Nanomaterials		
MSE 791			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems		
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing		
MAE 536	Micro/Nano Electromechanical Systems		
Concentration Requirement Courses		**12**	
Select a minimum of four of the following courses:			
MSE 702	Defects In Solids		
MSE 706	Phase Transformations and Kinetics		
MSE 708	Thermodynamics Of Materials		
MSE 710	Elements Of Crystallography and Diffraction		
MSE 715	Fundamentals Of Transmission Electron Microscopy		
MSE 721	Nanoscale Simulations and Modeling		
Technical Electives		**6**	
"Technical Electives" are approved in conjunction with the academic committee *			
Total Hours		**30**	

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- Materials engineer/scientist
- Bioinformatics
- Chemist
- Process engineer
- Materials analyst
- Professor
- Medical doctor
- PhD student

Nanoengineering (MR): Nanoelectronics and Nanophotonics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
Select four of the following courses:			
MSE 500	Modern Concepts in Materials Science		
MSE 565	Introduction to Nanomaterials		
MSE 791			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems		
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing		
MAE 536	Micro/Nano Electromechanical Systems		
Concentration Requirement Courses		**12**	
Select a minimum of four of the following courses:			
ECE 530	Physical Electronics		
ECE/BME 518	Wearable Biosensors and Microsystems		
ECE/MSE 589	Solid State Solar and Thermal Energy Harvesting		
ECE 723	Optical Properties Of Semiconductors		
CHE 560	Chemical Processing of Electronic Materials		
MSE 760	Materials Science in Processing of Semiconductor Devices		
MSE 771	Materials Science of Nanoelectronics		
Technical Electives		**6**	
"Technical Electives" are approved in conjunction with the academic committee *			
Total Hours		**30**	

* "Technical Electives" may be ones in the MNAE program not used to satisfy other degree requirements or other technical courses approved by the Director of Graduate Program, Nanoengineering.

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- Materials analyst
- Professor
- Medical doctor
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Nuclear Engineering

The discipline of nuclear engineering is concerned with the development of nuclear processes for energy production and with the applications of radiation for the benefit of society. Representative topics of investigation include analytical, computational and experimental research in the neutronics, materials, thermal-hydraulics and control aspects of fission reactors; radiation detection and measurement of basic physics parameters; nuclear safety and security; applications of radioisotopes and radiation in industry, medicine and science; and plasma science, plasma engineering and design aspects of fusion reactors.

Admission Requirements

Bachelor's degree graduates in any of the fields of engineering or physical sciences may be qualified for successful advanced study in nuclear engineering. Prior experience or course work in nuclear physics, partial differential equations and basic reactor analysis is helpful but may be gained during the first year of graduate study. GRE scores (general test) are needed for on-campus graduate study.

Master's Degree Requirements

A total of 30 credit hours (at least nine semester hours of interdisciplinary breadth and 21 Nuclear Engineering) is required for both the M.S. and MNE degrees. An engineering project is required for the MNE degree and a formal thesis is required for the M.S. degree.

Doctoral Degree Requirements

A total of 72 credit hours which includes a minor (at least 12 hours) is required. Students must pass a departmental qualifying exam in three core areas of nuclear engineering, and they can (if they so choose and if their advisor approves) prepare for the exam by enrolling during their first year in three corresponding graduate courses comprising radiation fundamentals, reactor engineering, and radiation detection. Students who already earned a masters degree may count some of their credits towards the required PhD hours; consult <grad manual posted online> for details.

Student Financial Support

Teaching assistantships, research assistantships, and fellowships are available for qualified applicants. Opportunities are also available for graduate traineeships with utility companies, reactor and fuel vendors, and national laboratories providing a valuable combination of financial support and learning in the classroom, the research laboratory and on the job.

Other Relevant Information

The department has many excellent facilities including the one-megawatt PULSTAR fission reactor (soon to be uprated to 2MW), ultra cold neutron source, intense low-energy positron source, neutron scattering facility, neutron radiography unit, neutron activation analysis laboratory, nuclear materials laboratory, plasma laboratories, instrumentation and controls equipment, radiation analyzers and tomography systems, Generic PWR simulator and access to extensive computer facilities ranging from workstations to a supercomputer.

Degrees

- Nuclear Engineering (MR) (p. 555)
- Nuclear Engineering (MS) (p. 556)
- Nuclear Engineering (PhD) (p. 558)
- Nuclear Engineering (Minor) (p. 559)

Faculty

Dmitriy Y. Anistratov

Yousry Y. Azmy

Mohamed Abdelhay Bourham

Nam Truc Dinh

Joseph M. Doster

Jacob Eapen

John G. Gilligan

Ayman I. Hawari

Kostadin Nikolov Ivanov

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Curtis Lee Smith

Rene Van Geemert

Louise Gail Worrall

Robert Joseph Zerr

Nuclear Engineering (MR)

Master of Nuclear Engineering Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18**	
Select 500 - 796 level courses approved in conjunction with the academic committee *			
Research Course		**3**	
NE 693	Master's Supervised Research		
Interdisciplinary Courses		**9**	
"Interdisciplinary Courses" are approved in conjunction with the academic committee to meet 30 total hours			
Total Hours		**30**	

* Students are required to take one course above the 700 level.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master’s (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor’s and Master’s degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master’s degree in the same field within 12 months of completing the Bachelor’s degree, or obtain a thesis-

based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

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Nuclear Engineering (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
Select 500 - 796 level courses approved in conjunction with the academic committee [*]			
Research Courses		**6**	
NE 693	Master's Supervised Research		
NE 695	Master's Thesis Research		
NE 699	Master's Thesis Preparation		
Interdisciplinary Courses		**9**	

"Interdisciplinary Courses" are approved in conjunction with the academic committee to meet 30 total hours	
Total Hours	**30**

* Students are required to take one course above the 700 level.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Nuclear Engineering (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
Select 500 - 796 level courses approved in conjunction with the academic committee [1]			
Research Courses		**21**	
NE 893	Doctoral Supervised Research		
NE 895	Doctoral Dissertation Research		
NE 899	Doctoral Dissertation Preparation		
Additional Courses		**30**	
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours [2]			
Total Hours		**72**	

1 Students are required to take two courses above the 750 level.

2 "Additional Courses" may include NE courses, Research courses, and Interdisciplinary courses.

Faculty

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Nuclear Engineering (Minor)

Plan Requirements

Master's Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a minimum of three 500 - 796-level courses approved in conjunction with the Academic Committee *			
Total Hours		**9**	

PhD Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four 500 - 796-level courses approved in conjunction with the Academic Committee *			
Total Hours		**12**	

* To receive a Master's Minor, students must take at least one course above the 700-level; to receive a PhD Minor, students must take at least one course above the 750-level.

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Graduate Certificates - College of Engineering

Certificates

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5G Technologies (Certificate)

Plan Requirements

Students may choose from the course tracks below to complete coursework within a focus area.

Certificates earned will be distributed as: "Graduate Certificate in 5G Technologies" without focus area track specifications.

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECE 592	Special Topics In Electrical Engineering (LTE and 5G Communications (EOL))		
Select a course sequence under any track area listed under "Focus Area Tracks"			
Total Hours		**12**	

Focus Area Tracks

Circuits

Code	Title	Hours	Counts towards
Course Sequence			
ECE 511	Analog Electronics		
ECE 712	Integrated Circuit Design for Wireless Communications		
ECE 792	Special Topics In Electrical Engineering (Design of Millimeter-Wave Circuits and Systems (EOL))		

Microwave Systems and Applied EM

Code	Title	Hours	Counts towards
Course Sequence			
ECE 524	Radio System Design		
ECE 549	RF Design for Wireless		
ECE 592	Special Topics In Electrical Engineering (Antennas and Arrays)		

Communications

Code	Title	Hours	Counts towards
Course Sequence			
ECE 575	Introduction to Wireless Networking		
ECE 766	Signal Processing for Communications & Networking		
ECE 570	Computer Networks		

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ASIC Design & Verification (Certificate)

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECE 564	ASIC and FPGA Design with Verilog		
ECE 745	ASIC Verification		
ECE 748	Advanced Functional Verification with Universal Verification Methodology		
ECE 546	VLSI Systems Design		
or ECE 720	Electronic System Level and Physical Design		
Total Hours		**12**	

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Computer Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four ECE courses at the 500- or 700-level *			
Total Hours		**12**	

* Courses are limited to Computer Engineering or cross-listed courses. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

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Computer Science (Certificate)

Those interested in developing their computer science knowledge and skills, but not ready to commit to a degree program, might consider the online/on-campus Computer Science Graduate Certificate. Students who complete the certificate will gain in-depth knowledge in Computer Science concepts, methods and tools. Applicants are expected to have an accredited Bachelor of Science degree in Computer Science or any sciences or engineering discipline. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

Certificate in Computer Science

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four CSC courses at the 500- or 700-level – see optional tracks listed below			
Total Hours		**12**	

Computer Science Foundations Track

Code	Title	Hours	Counts towards
Theory Core			
Complete two		6	
CSC 503	Computational Applied Logic		
CSC 505	Design and Analysis Of Algorithms		
CSC 512	Compiler Construction		
CSC 565	Graph Theory		
CSC 574	Computer and Network Security		
CSC 579	Introduction to Computer Performance Modeling		
CSC 580	Numerical Analysis I		
CSC 707	Automata, Languages and Computability Theory		
Systems Core			
Complete two		6	
CSC 501	Operating Systems Principles		
CSC 506	Architecture Of Parallel Computers		
CSC 510	Software Engineering		
CSC 514	Foundations of Cryptography		
CSC 520	Artificial Intelligence I		
CSC 540	Database Management concepts and Systems		
CSC 561	Principles of Computer Graphics		
CSC 570	Computer Networks		
Total Hours		**12**	

Networking Track

Code	Title	Hours	Counts towards
Core Courses			
Complete at least one		3-6	
CSC 570	Computer Networks		
CSC 573	Internet Protocols		

Elective Courses		
Complete at least two		6-9
CSC 574	Computer and Network Security	
CSC 575	Introduction to Wireless Networking	
CSC 577	Switched Network Management	
CSC 591	Special Topics In Computer Science (Topics Include: Internet of Things Analytics; Software Defined NetworkingInterne of Things: Application and Implementation; Internet of Things: A Primer; Network Design and Management; Network Science;)	
CSC 773	Advanced Topics in Internet Protocols	
CSC 774	Advanced Network Security	
Total Hours		**12**

Security/Privacy Track

Code	Title	Hours	Counts towards
Core Course			
Following courses is required to complete the Security/Privacy Track:			
CSC 574	Computer and Network Security	3	
Elective Courses			
Complete at least three		9	
CSC 514	Foundations of Cryptography		
CSC 515	Software Security		
CSC 705	Operating Systems Security		
CSC 533	Privacy in the Digital Age		
CSC 591	Special Topics In Computer Science		
Total Hours		**12**	

Systems Track

Code	Title	Hours	Counts towards
Core Courses			
Complete at least one		3-6	
CSC 501	Operating Systems Principles		
CSC 548	Parallel Systems		
Elective Courses			
Complete at least two		6-9	
CSC 506	Architecture Of Parallel Computers		
CSC 512	Compiler Construction		
CSC 547	Cloud Computing Technology		
CSC 568	Enterprise Storage Architecture		
CSC 591	Special Topics In Computer Science (Topics Include: Data-Intensive Computing; Reliable Time Computer Systems)		
CSC 714	Real Time Computer Systems		
CSC 724	Advanced Distributed Systems		
CSC 766	Code Optimization for Scalar and Parallel Programs		
Total Hours		**12**	

Data Science Foundations (Certificate)

This online/on-campus program is well suited for working professionals who have some formal training in Computer Science and/or Statistics and wish to acquire a basic understanding of data science. Applicants are expected to have an accredited Bachelor of Science degree in either a sciences or engineering discipline, Computer Science or Statistics. A minimum GPA of 3.0, on a 4-point scale, is also expected. The GRE is not required for admission.

Financial aid is not available through our program. Interested applicants will need to review other means of assistance, if needed.

Certificate in Data Science Foundations

Code	Title	Hours	Counts towards
Required Courses		**6-9**	
Complete a minimum of two courses from "Core Courses" listed below			
Elective Courses		**3-6**	
Complete minimum of one course from "Elective Courses" listed below			
Total Hours		**12**	

Required Courses

Code	Title	Hours	Counts towards
Select minimum of two courses from the following: [1]		**6-9**	
CSC 505	Design and Analysis Of Algorithms		
CSC 541	Advanced Data Structures		
ST 517	Applied Statistical Methods I		
ST 563	Introduction to Statistical Learning		

Elective Courses

Code	Title	Hours	Counts towards
Select minimum of one course from the following		**3-6**	
CSC 522	Automated Learning and Data Analysis [2]		
CSC 540	Database Management concepts and Systems		
CSC 591	Special Topics In Computer Science (Topics include: Data Driven Business Intelligence; Graph Data Mining; Spatial and Temporal Data Mining)		
ST 540	Applied Bayesian Analysis		

1 Students must take at least one ST and one CSC course

2 Credit cannot be given for both CSC 522 Automated Learning and Data Analysis and ST 563 Introduction to Statistical Learning

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Downstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Downstream Biomanufacturing graduate certificates offer NC State graduate students and working professionals the opportunity for hands-on learning in BTEC's industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC's graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
BEC 532	Foundations of Downstream Processing and Formulation		
BEC 536	Introduction to Downstream Process Development		
BEC 585	cGMP Downstream Operations		
BEC 575	Global Regulatory Affairs for Medical Products		
Elective Course		**3**	
Select a minimum of three credits of the following:			
BEC 515	Biopharmaceutica Product Characterization Techniques		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
BEC 590	Industry Practicum in Biomanufacturing		
BUS 554	Project Management		
Total Hours		**12**	

Electrical Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of four ECE courses at the 500- or 700-level			
Total Hours		**12**	

* Courses must be Electrical Engineering or cross-listed as either. Excludes Special Topics Courses: ECE 592, ECE 791, and ECE 792.

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Health Physics (Certificate)

The Graduate Certificate in Health Physics (GCHP) is intended to support industry, government, military and the national laboratories with expertise in radiation safety for workers who have not had formal education in the same. Many engineers and specialists work in the nuclear field who might be mechanical, electrical or civil engineers, etc. and may seek to supplement this education with radiation safety science and technology. Even graduate nuclear engineering students often have interest in health physics and obtaining this credential will enable them to demonstrate to future employers a meaningful commitment and basic competence in the same. It is further intended that this curriculum will assist students seeking to eventually become certified as health physicists through the American Board of Health Physics. This certificate is intended to help prepare students for the Board exam, and to qualify them to obtain professional experience that is also required for certification.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
NE 504	Radiation Safety and Shielding		
NE 590	Health Physics and Radiological Emergency Response		
Additional Courses		**6**	
Select two courses from the following:			
NE 520	Radiation and Reactor Fundamentals		
NE 521	Principles of Radiation Measurement		
NE 531	Nuclear Waste Management		
NE 777	Radiological Assessment		
Total Hours		**12**	

Materials Science and Engineering (Certificate)

The Graduate Certificate Program (GCP) in Materials Science and Engineering (MSE) is designed for working professionals who do not have formal training in MSE, but wish to acquire a basic understanding of materials science to improve their on-the-job experience and knowledge. Most people will enroll in this program as distance education students through the Engineering Online (EOL) office at NC State University. Students can customize their particular certificate programs to focus on specific areas of materials science that interest them.

Program of Study

The MSE GCP requires a total of 12 credit hours, including MSE 500 (3 credit hours) and three MSE elective courses (9 credit hours) selected by the student. MSE 500 is a fast-paced overview of the field of materials science and engineering and is designed for students who do not have a formal background in MSE, such as those with BS degrees in chemistry, physics and other fields of engineering. MSE 500 also provides the foundation for more specialized MSE graduate courses.

Each course is 3 credit hours and most courses are offered at least once per year through the EOL office. By judicious selection of elective courses, students can customize their GCP to focus on areas of interest to them.

Admissions Requirements

To be admitted to the MSE Graduate Certificate Program, a student must have a BS degree in the sciences or engineering from a regionally accredited four-year college or university, and have an overall (or major) GPA of at least 3.0 on a 4-point scale.

All new students must complete the NCSU Graduate School application for admission to the MSE GCP. The GRE exam is NOT required for admission to the GCP. Application deadlines are March 1 for summer and fall admission, and October 1 for spring admission. Students can begin study in the fall, spring or summer semester immediately following their acceptance into the program.

Academic success in the MSE GCP might have a strong bearing on admission to a graduate degree program. However, completion of a graduate certificate program IN NO WAY guarantees entry into a graduate degree program, which must be done through a separate application process.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
MSE 500	Modern Concepts in Materials Science		
Select a minimum of three courses from "MSE Courses" listed below			
Total Hours		**12**	

MSE Courses

Code	Title	Hours	Counts towards
Select a minimum of three of the following courses:		**9**	
MSE/NE 509	Nuclear Materials		
MSE 540	Processing of Metallic Materials		
MSE 545	Ceramic Processing		
MSE 555	Polymer Technology and Engineering		
MSE 556	Composite Materials		
MSE 560	Microelectronic Materials Science and Technology		
MSE 561	Organic Chemistry Of Polymers		
MSE 565	Introduction to Nanomaterials		
MSE 566	Mechanical Properties of Nanostructured Materials		
MSE 576	Technology Entrepreneurship and Commercialization I		
MSE 577	Technology Entrepreneurship and Commercializatior II		
MSE 580	Materials Forensics and Degradation		
MSE 589	Solid State Solar and Thermal Energy Harvesting		
MSE 702	Defects In Solids		
MSE 703	Interaction of Electrons with Materials		
MSE 704	Interaction of Photons with Materials		
MSE 705	Mechanical Behavior Of Engineering Materials		
MSE 706	Phase Transformations and Kinetics		
MSE 708	Thermodynamics Of Materials		
MSE 709	Metastable Materials: Processing, Structure, and Properties		
MSE 710	Elements Of Crystallography and Diffraction		
MSE 712	Scanning Electron Microscopy		
MSE 715	Fundamentals Of Transmission Electron Microscopy		
MSE 718	Advanced Transmission Electron Microscopy		
MSE 721	Nanoscale Simulations and Modeling		
MSE 723	Materials Informatics		
MSE 731	Materials Processing by Deformation		
MSE 741	Principles of Corrosion		
MSE 751	Thin Film and Coating Science and Technology I		
MSE 752	Thin Film and Coating Science and Technology II		
MSE/NE 757	Radiation Effects on Materials		
MSE 760	Materials Science in Processing of Semiconductor Devices		

MSE 761	Polymer Blends and Alloys	
MSE 763	Characterization Of Structure Of Fiber Forming Polymers	
MSE 770	Defects, Diffusion and Ion Implantation In Semiconductors	
MSE 771	Materials Science of Nanoelectronics	
MSE 775	Structure of Semicrystalline Polymers	
MSE 791	Advanced Topics in Materials Science and Engineering	
MSE 795	Advanced Materials Experiments	
Total Hours		**9**

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John T. Prater

Justin Schwartz

Victor Zhirnov

Nano-Systems Engineering (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECE/CHE 568	Conventional and Emerging Nanomanufacturin Techniques and Their Applications in Nanosystems	3	
MBA 576	Technology Entrepreneurship and Commercialization I	3	
Micro-Machined Sensors and Actuators			
Select six credit hours of the following Core Electives:		6	
BME 590	Special Topics in Biomedical Engineering (Nanobiotechnolo		
BME 590	Special Topics in Biomedical Engineering (Biosensors)		
CHE 596	Special Topics in Chemical Engineering (Nano-scale films and surfaces)		
CHE 596	Special Topics in Chemical Engineering (Colloid Science and Nano-Scale Engineering)		
ECE 538	Integrated Circuits Technology and Fabrication		
ECE 739	Integrated Circuits Technology and Fabrication Laboratory		
ECE 792	Special Topics In Electrical Engineering (Self-Powered Nano-Systems)		

ECE 592	Special Topics In Electrical Engineering (Micro-Machined Sensors and Actuators)	
ISE 718	Micro/ Nano-Scale Fabrication and Manufacturing	
MAE 536	Micro/Nano Electromechanical Systems	
MAE 589	Special Topics In Mechanical and Aerospace Engineering (Micro-transducers)	
MSE 760	Materials Science in Processing of Semiconductor Devices	
MSE 771	Materials Science of Nanoelectronics	
MSE 791	(Introduction to Nano-Materials)	
Select three hours of the following Technical Electives:		3
BME 525	Bioelectricity	
BME 566	Polymeric Biomaterials Engineering	
ECE 557	Principles Of MOS Transistors	
ECE 724	Electronic Properties Of Solid-State Devices	
ECE 723	Optical Properties Of Semiconductors	
ECE 530	Physical Electronics	
ECE 592	Special Topics In Electrical Engineering (Bioelectricity and Neural Interfaces)	
ECE 592	Special Topics In Electrical Engineering (Organic Electronics and LCDs)	
ISE 714	Product Manufacturing Engineering for the Medical Device Industry	
Total Hours		**15**

Nanobiotechnology (Certificate)

With financial support from the North Carolina Biotechnology Center, UNC-Chapel Hill and NC State University offer graduate certificates in nanobiotechnology. Tremendous advances in development of nanoscale, nanostructured, and nano-enabled materials for biotechnology applications are currently taking place. In particular, the development of advanced materials (e.g., electronic materials, optical materials, biologically-derived materials, and nanoscale materials) will allow for the development of next generation systems for use in medicine, homeland defense, and agriculture. These systems will provide integration of multiple functions, miniaturization of devices, an increase in stability, and a decrease in cost. In order for universities, companies, and governmental agencies to pursue this highly specialized work, students must be trained at the graduate level to perform work at the interface of nanoscale science and biotechnology. The nanobiotechnology certificates are aligned with the need for highly trained professionals to nurture rapid growth of nanobiotechnology infrastructure in North Carolina. The keystone of the certificates at both universities is a core nanobiotechnology course (BME 540, 3 credit hours), in which lectures, open discussion, and student presentations will be used to introduce students to this area of study.

Plan Requirements

Code	Title	Hours	Counts towards
BME 540	Nanobiotechnology Processing, Characterization, and Applications	3	
Select nine hours of electives:		9	
BEC/CHE 562	Fundamentals of Bio-Nanotechnology (courses also offered at UNC-CH)		
CH 747	Nanobiotechnolog		
BIT 501	Ethical Issues in Biotechnology		
BME 566	Polymeric Biomaterials Engineering		
MSE 539	Advanced Materials		
Total Hours		**12**	

Renewable Electric Energy Systems (Certificate)

The Graduate Certificate in Renewable Electric Energy Systems provides graduate students with the opportunity to develop expertise in renewable

electric energy systems and advanced electric power grid technology in addition to their major area of graduate study.

Admissions

Applicants with appropriate background must meet one of the three following requirements:

- be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- be a degree student in good standing in an NC State University graduate program; or
- have a Master's degree in a related field of study.

A student may obtain more than one graduate certificate in a different field. Each certificate must have at least nine (9) credit hours that are unique to it.

Requirements

The Graduate Certificate in Renewable Electric Energy Systems requires a minimum of 12 hours, including one 3-hour core course and 9 credit hours of electives to be selected from a list that contains relevant courses for the certificate. Students must maintain a minimum overall GPA of B (3.0).

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
ECE 552	Renewable Electric Energy Systems	3	
Select three of the following Advanced Courses:		9	
ECE 550	Power System Operation and Control		
ECE 581	Electric Power System Protection		
ECE 534	Power Electronics		
ECE 551	Smart Electric Power Distribution Systems		
ECE 535	Design of Electromechanical Systems		
ECE 585	The Business of the Electric Utility Industry		
ECE 589	Solid State Solar and Thermal Energy Harvesting		
ECE 736	Power System Stability and Control		
Total Hours		**12**	

Upstream Biomanufacturing (Certificate)

Graduate students and working professionals can now earn a new credential to kick-start or advance their career in the biopharmaceutical industry. The Upstream Biomanufacturing graduate certificates offer NC State graduate students and working professionals the opportunity for hands-on learning in BTEC's industry-scale simulated cGMP facilities.

Each certificate requires 12 hours of graduate coursework, which can be transferred to the Master of Biomanufacturing program. The majority of BTEC's graduate courses are offered in the evening or online to better accommodate working professionals.

The certificate can be completed in two part-time semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
CHE 563	Fermentation of Recombinant Microorganisms		
BBS 526	Upstream Biomanufacturing Laboratory		
BEC 580	cGMP Fermentation Operations		
BEC 577	Advanced Biomanufacturing and Biocatalysis		
Elective Course		**3**	
Select a minimum of three credits of the following:			
BEC 588	Animal Cell Culture Engineering		
BEC 575	Global Regulatory Affairs for Medical Products		
BEC 525	Molecular Biology for Biomanufacturing		
BEC 545	Cell Line Development for Biomanufacturing		
BIT 510	Core Technologies in Molecular and Cellular Biology		

BIT 566	Animal Cell Culture Techniques	
Total Hours		**12**

College of Humanities and Social Sciences

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- Communication, Rhetoric, and Digital Media (p. 584)
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Anthropology

We offer a 30-hour, two-year long graduate program culminating in the Master of Arts degree with specializations in cultural anthropology, biological anthropology, and archaeology. Our faculty conduct research across the globe and prepare our students to enter top-ranked doctoral programs and to find satisfying careers in non-academic and applied settings. Students have the option to complete a master’s thesis, which we recommend for those considering going on to a PhD program, or a capstone project for those considering non-academic careers.

Financial Support

A limited number of Graduate Student Assistantships are available on a competitive basis.

Admissions Requirements

In addition to general Graduate School requirements, applicants are required to provide a completed application, including transcripts, three letters of recommendation, a personal statement, and a writing sample. CV or resume is optional but encouraged. GRE scores are not required. The deadline for completed applications is January 10. The curriculum is set for fall admission only.

Master's Degree Requirements

The M.A. degree requires a total of 30 credit hours. All students take an introduction to anthropological research course in their first semester (ANT 501) and select a specialty area, such as archaeology, bioarchaeology, or cultural anthropology. Students who write a master's thesis will take six hours of thesis research credit (ANT 695). Students completing a capstone project (also known as a non-thesis, or Option B) take one independent study (ANT 598) and one additional course in place of the six hours of ANT 695 credit.

Degrees

- Anthropology (MA) (p. 579)
- Anthropology (Minor) (p. 581)

Faculty

Full Professors

Daniel Troy Case

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Anthropology (MA)

Degree Requirements

Students may choose from the thesis tracks and course specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Arts in Anthropology" without specialization or track specifications

Code	Title	Hours	Counts towards
Required Courses		**30**	
Select one specialization below			
Select one research track below			
Total Hours		**30**	

Specializations

Biological Anthropology

Code	Title	Hours	Counts towards
Required Courses		**18**	
ANT 501	Proseminar: Introduction to Graduate Studies in Anthropology		
ANT 511	Overview of Anthropological Theory		
ANT 521	Human Osteology		
ST 511	Statistical Methods For Researchers I		
ANT 583	Theories of Archaeological Research		
Select six credit hours of the following: [1]			
ANT 524	Bioarchaeology		
ANT 528	Human Paleopathology		
ANT 585	Skeletal Biology in Anthropology (can be Biological, Cultural, or Archaeology)		
Elective Courses		**9**	
Select three credit hours of additional electives [2]			

	Additional ANT credit hours or advised coursework [3]	
Total Hours		**27**

1. Counts toward 6 hours of additional biological anthropology electives
2. Can be Biological, Cultural, or Archaeology
3. Total depends on thesis or plan B

Cultural Anthropology

Code	Title	Hours	Counts towards
Cultural Anthropology Specialization Required Courses		**15**	
ANT 501	Proseminar: Introduction to Graduate Studies in Anthropology		
ANT 511	Overview of Anthropological Theory		
ANT 516	Research Methods in Cultural Anthropology		
Select six credit hours of the following: [1]			
ANT 512	Applied Anthropology		
ANT 544	Cross-Cultural Perspectives on Women		
ANT 550	Culture, Ecology, and Sustainable Living		
ANT 560	Urban Anthropology		
Elective Courses		**12**	
Select three credit hours of additional electives [2]			
Additional ANT credit hours or advised coursework [3]			
Total Hours		**27**	

1. Counts toward six hours of additional biological anthropology electives
2. Can be Biological, Cultural, or Archaeology
3. Total depends on Thesis Track Option

Archaeology

Code	Title	Hours	Counts towards
Required Courses		**18**	
ANT 501	Proseminar: Introduction to Graduate Studies in Anthropology		
ANT 511	Overview of Anthropological Theory		
ANT 583	Theories of Archaeological Research		
ANT 575	Environmental Archaeology [1]		
or ANT 587	Cultural Resource Management		
Elective Courses		**9**	
Select three credit hours of additional electives [2]			
Additional ANT credit hours or advised coursework [3]			
Total Hours		**27**	

1. Counts toward 6 hours of additional biological anthropology electives
2. Can be Biological, Cultural, or Archaeology
3. Total depends on thesis or plan B

Research Tracks

Thesis Track

Code	Title	Hours	Counts towards
Required Courses		**9**	
ANT 693	Masters Supervised Research		
ANT 695	Masters Research		
ANT 699	Masters Thesis Preparation		

Plan B Track

Code	Title	Hours	Counts towards
Required Course		**3**	
ANT 598	Independent Study in ANT (independent study with advisor for plan B only)		

Faculty

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Anthropology (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Communications

The Master of Science program in communication is designed to provide graduate-level expertise for solving problems in modern organizations and social systems from a communication perspective. The curriculum addresses issues concerned with interpersonal, relational and technologically mediated communication systems essential to modern, networked organizations and societies. Its graduates will acquire advanced-level expertise in communication theory, research, and applications that will improve processes and enhance outcomes within and across diverse social systems. The degree prepares students for higher-level positions in communication professions and for advanced degree programs (e.g., Ph.D. programs).

Admission Requirements

Applicants should have a minimum 3.0 GPA in the undergraduate major and a minimum of 3.0 over the last 60 hours of undergraduate work.

Master's Degree Requirements

The degree requires 36 credit hours with a minimum of 27 credit hours taken in communication. Students will be required to complete 9 hours of core requirements, and 27 hours of electives, 9 of which can be taken outside of the department with the approval of the graduate advisor. Students can also take up to 6 internship or independent study credit hours. Students on the thesis track can take up to 6 thesis credit hours.

Degrees

- Communications (MS) (p. 582)

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Communications (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
COM 540	Critical and Interpretive Inquiry in Communication		
COM 541	Quantitative Research Methods in Applied Communication		
COM 542	Qualitative Research Methods in Applied Communication		
COM 561	Human Communication Theory		
Elective Courses		**9**	
Select nine credit hours of COM electives – see "Elective Courses" listed below			
Thesis Courses		**9**	
Thesis Option			
COM 695	MR Thesis Research		
COM 696	Summer Thesis Res		
Non-Thesis Option			
COM 688	Non-Thesis Masters Continuous Registration - Half Time Registration		
COM 689	Non-Thesis Master Continuous Registration - Full Time Registration		
Total Hours		**30**	

Elective Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses below:		**9**	
COM 514	History Of Rhetoric	3	
COM 516	Rhetorical Criticism: Theory and Practice	3	

COM 521	Communication and Globalization	3
COM 522	Critical Approaches to Organizational Communication	3
COM 523	International and Intercultural Communication	3
COM 525	Group/Team Communication	3
COM 526	Media Economics	3
COM 527	Seminar in Organizational Conflict Management	3
COM 529	Communication Campaigns	3
COM 530	Interpersonal Communication in Science and Technology Organizations	3
COM 532	Communication Consulting	3
COM 536	Seminar in Environmental Communication	
COM 537	Gaming and Social Networks	3
COM 538	Risk Communication	3
COM 539	Fund Development	3
COM 540	Critical and Interpretive Inquiry in Communication	3
COM 541	Quantitative Research Methods in Applied Communication	3
COM 542	Qualitative Research Methods in Applied Communication	3
COM 543	Visual Content Analysis	3
COM 546	Nonprofit Marketing and Public Relations	3
COM 547	Mobile Media and Communication	3
COM 554	Contemporary Rhetorical Theory	3
COM 562	Communication and Social Change	3
COM 563	Public Relations Theory	3
COM 566	Seminar In Crisis Communication	3
COM/ENG 581	Visual Rhetoric: Theory and Criticism	3
COM 585	Teaching College Communication	3
COM 598	Special Topics In Communication	1-6
COM 598	Special Topics In Communication (Communication in Groups and Teams)	1-6
COM 598	Special Topics In Communication (International Public Relations)	1-6
COM 630	Independent Study in Communication	1-3
COM 650	Communication Internship	1-6
COM 685	Master's Supervised Teaching	1-3
COM 695	MR Thesis Research	1-6

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Robert Laurence Schrag

Craig Allen Smith

Sarah R Stein

Communication, Rhetoric, and Digital Media

The Ph.D. Program in Communication, Rhetoric, and Digital Media prepares doctoral students to analyze the social, cultural, rhetorical, philosophical, and political dimensions of information technologies, new communication media, and digital texts, and to actively engage digital media through research, criticism, production, and practice.

Students work with program faculty from the departments of Communication and English and with affiliated faculty from departments across the university and the broader UNC system to study oral, written, visual, computational, and multimodal forms of communication and rhetoric; to examine the transformation of communication in the context of converging digital media and communication networks; and to address the theoretical and practical challenges of innovative, interdisciplinary research.

Students can create programs of study in areas such as Social Media, Interpersonal Communication, Environmental Communication, Critical Making, Emerging Digital Genres, Multimedia Research in Digital Media, Composition Studies, Digital Humanities, Rhetoric Theory, Digital Rhetoric, Visual Rhetoric, Digital Media Production, Science and Technology Studies, Risk Communication, Organizational Communication, Mobile Communication, Technology and Pedagogy, Game Studies, Online Information Design, Public Relations, Technical and Professional Communication, Digital Literacies, Transcultural Communication, Visual Communication, and Cultural Studies.

Faculty guide students in their work by using a broad range of social scientific and humanistic methods in which they specialize. The program offers comprehensive mentoring for professional development, diverse opportunities for teaching experience, and research assistantships associated with grant-funded faculty projects. CRDM faculty and students collaborate with colleagues in science and technology fields across the university and the Research Triangle.

Our graduates have been very successful finding employment in a variety of positions in academia (both at research-intensive universities and at teaching-oriented liberal arts colleges), government and corporate organizations, where there is a growing demand for the interdisciplinary skill sets developed in CRDM.

Admission Requirements

Master’s degree in Communication, English, Rhetoric, or other relevant field with GPA of 3.0 or better. Master’s level work should include one quantitative or qualitative methods course, as well as three courses in an approved disciplinary area. These hours do not count toward the doctoral degree. Disciplinary areas include: composition studies, including writing across the curriculum, interpersonal/group communication, media studies, organizational communication or public relations, rhetorical studies, and technical communication.

Applicants who are otherwise well qualified may make up these courses after admission. Three reference letters, a statement of goals and interests, a resume of work experience, and a writing sample are also required for application to the program. GRE is not required. The application deadline is January 15th.

Ph.D. Degree Requirements

A minimum of 56 hours beyond the Master's degree are required to complete the Ph.D. program: 15 credit hours of core courses, 3 hours of research methods, 6 hours of professional preparation, 12 hours in an elective focus area, and 20 hours of research and dissertation.

Student Financial Support

The CRDM program offers a limited number of Teaching Assistantships, with a stipend, health insurance, and tuition (excluding fees). Teaching Assistants will be assigned according to their interests and qualifications, as well as departmental needs, to either the Communication or the

English Department with the possibility of teaching in both departments during their course of study. Those who do not have sufficient qualifications to teach in the first semester will participate in a training program. Some Research Assistantships may also be available.

Degrees

- Communication, Rhetoric, and Digital Media (PhD) (p. 585)

Faculty

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Zachary Beare

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Yang Cheng

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Robert S. Dicks

William J. Jordan

Susan M. Katz

William J. Kinsella

Carolyn Rae Miller

Devin A. Orgeron

Ann M. Penrose

Robert Laurence Schrag

Sarah R. Stein

Communication, Rhetoric, and Digital Media (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
CRD 701	History and Theory of Media Technologies		
CRD 702	Rhetoric and Digital Media		
CRD 703	Communication Networks		
CRD 704	Communication, Technologies, and Pedagogy		
CRD 790	Scholarly and Professional Paths in Disciplinary and Interdisciplinary Research		

Select one of the following:		
COM 541	Quantitative Research Methods in Applied Communication	
COM 543	Visual Content Analysis	
ENG 508	Usability Studies for Technical Communication	
ENG 513	Empirical Research In Composition	
COM 581	Visual Rhetoric: Theory and Criticism	
ENG 543	Introduction to Digital Humanities [1]	
Select one of the following:		
COM/ENG 506	Verbal Data Analysis	
COM/ENG 516	Rhetorical Criticism: Theory and Practice	
COM 540	Critical and Interpretive Inquiry in Communication	
COM 542	Qualitative Research Methods in Applied Communication	
COM 543	Visual Content Analysis	
ENG 527	Discourse Analysis	
ENG 532	Narrative Analysis	
ENG 587	Interdisciplinary Studies in English	
ENG 513	Empirical Research In Composition (Methods and Theories in Media studies)	
Elective Courses		**12**
Select an elective focus approved in conjunction with the academic committee		
Additional Courses		**19**
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours		
CRD 809	Colloquium in Communication, Rhetoric, and Digital Media	
COM 585	Teaching College Communication	
ENG 511	Theory and Research In Composition	
CRD 885	Doctoral Supervised Teaching	
Dissertation and Exam courses		**20**
Select 20 credit hours of Exams and Dissertation courses of the following:		
CRD 895	Doctoral Dissertation Research	
CRD 893	Doctoral Supervised Research [2]	
CRD 899	Doctoral Dissertation Preparation	
ENG/COM 810	Directed Readings in English Studies	
Total Hours		**72**

[1] ENG 543 Introduction to Digital Humanities is Interdisciplinary Studies in English. Not all topics will fulfill a methods course.

[2] Minimum 6/20 credits

Faculty

Full Professors

Deanna P. Dannels

Adriana Araujo de Souza e Silva

Victoria J. Gallagher

Jessica Katz Jameson

Melissa A. Johnson

Joann Keyton

William J. Kinsella

Robert Laurence Schrag

Kenneth S. Zagacki

Associate Professors

Andrew Ray Binder

Elizabeth Ann Craig

James Kiwanuka-Tondo

Kama A. Kosenko

Sarah R. Stein

Stephen B. Wiley

Assistant Professors

Yang Cheng

Fernanda Duarte

Nicole Marie Lee

Emeritus Faculty

Daniel A. DeJoy

Edward T. Funkhouser

William J. Jordan

Rebecca Leonard

Burton Lester Russell

Robert Laurence Schrag

Craig Allen Smith

Sarah R Stein

Creative Writing

The Department of English offers a two-year studio/academic program in fiction or poetry leading to the Master of Fine Arts degree. The program provides an opportunity for students of superior and demonstrated ability in imaginative writing to develop their skills and critical judgment through the practice of writing and the study of literature. The aim of the program is to prepare talented students for careers in writing. Degree candidates are expected to produce a book-length work of literary value and publishable quality.

Admission Requirements

Overall GPA of 3.0 or higher; applicants should submit GRE scores (general aptitude and analytical writing); one official transcript of all undergraduate and graduate work; two letters of recommendation; and two writing samples, one creative, one critical. Creative sample: for fiction, two short stories, or for a novel, three chapters (or one chapter and a short story) totaling 25-40 pages; for poetry, 12 complete poems. Critical sample: no more than 15 pages of writing demonstrating your ability to succeed in graduate-level literature classes, a required part of the MFA curriculum.

Requirements for the MFA in Creative Writing

Candidates for the MFA degree must complete a total of 36 credits. Eighteen of these are taken in the area of writing specialization. These include workshop courses (12 credits) and thesis (6 credits). The remaining credits are taken in literature (6 credits) and elective areas (12 credits, including 6 credit hours of teaching preparation for those on a composition teaching assistantship). In their final semester, students must pass a comprehensive written examination on writing craft, based on a book list selected jointly by the student and the faculty. The final thesis must be a book-length manuscript in the student's field of interest. In fiction, an approximate 200 pages are expected; in poetry, 60 pages. See program website for specific requirements by concentration.

Student Financial Support

All students admitted to the MFA program are eligible for teaching assistantships. TAs in the MFA train to teach undergraduate composition courses, and a few selected creative writing classes.

Other Relevant Information

Application deadline is February 1. Students are admitted for the fall semester only.

The English department has a long tradition of academic and literary excellence, including its heritage of writers from Guy Owen to Lee Smith. The strength of NCSU in the sciences offers students the opportunity to do creative work that engages with issues of technology and its effect on individuals and institutions that are not typically addressed in fine arts programs.

Through the NC State Literary Readings Series, the department sponsors readings and visits by distinguished poets, fiction and non-fiction writers.

Degrees

- Creative Writing (MFA) (p. 588)

Faculty

Full Professors

Wilton Barnhardt

Belle McQuaide Boggs

Eduardo C. Corral

Dorianne Louise Laux

Assistant Professors

Maya L. Kapoor

Cadwell Turnbull

Practice/Research/Teaching Professors

John J. Kessel

Jill Collins McCorkle

Joseph H. Millar

Creative Writing (MFA)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ENG 588	Fiction Writing Workshop		
ENG 589	Poetry Writing Workshop		
Select six credit hours of the following:			
ENG 509	Old English Literature		
ENG 510	Middle English Literature		
ENG 529	16th-Century Non-Dramatic English Literature		
ENG 530	17th-Century English Literature		
ENG 531	American Colonial Literature		
ENG 539	Seminar In World Literature		
ENG 548	African-American Literature		
ENG 549	Modern African Literature		
ENG 550	British Romantic Period		
ENG 551	Chaucer		
ENG 558	Studies In Shakespeare		
ENG 560	British Victorian Period		
ENG 561	Milton		
ENG 562	18TH-Century English Literature		
ENG 563	18TH-Century English Novel		
ENG 564	Victorian Novel		
ENG 565	American Realism and Naturalism		
ENG 570	20TH-Century British Prose		
ENG 571	20TH-Century British Poetry		
ENG 572	Modern British Drama		
ENG 573	Modern American Drama		
ENG 575	Southern Writers		
ENG 576	20TH-Century American Poetry		
ENG 577	20th-Century American Prose		
ENG 578	English Drama To 1642		
ENG 579	Restoration and 18th-Century Drama		
ENG 580	Literary Postmodernism		
ENG 582	Studies in Literature		
Additional literature courses are approved in conjunction with the academic committee			
Elective Courses		**12**	
Select a minimum of 12 credit hours of electives approved in conjunction with the academic committee			
Thesis Research Course		**6**	
ENG 695	Master's Thesis Research		
Total Hours		**30**	

Faculty

Full Professors

Wilton Barnhardt

Belle McQuaide Boggs

Eduardo C. Corral

Dorianne Louise Laux

Assistant Professors

Maya L. Kapoor

Cadwell Turnbull

Practice/Research/Teaching Professors

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English

The M.A. is a 33-hour program offered in four concentrations: literature, rhetoric and composition, linguistics and film studies. Regardless of which path you choose, you'll select from a broad array of courses that will help you meet your personal and professional goals.

Admissions Requirements

Students must submit a personal statement, writing sample, and three letters of recommendations. The application deadline is June 15 for fall semester admission and November 1 for spring. The application deadline to be considered for a teaching assistantship is February 1. Students are admitted for either the fall or spring semesters.

Requirements for MA in English

We offer four areas of concentration that represent distinct dimensions of our discipline. Focus Tracks are as follows:

- Film Studies (p. 590)
- Linguistics (p. 591)
- Literature (p. 591)
- Rhetoric and Composition (p. 593)

Degrees earned will be distributed as: "Master of Arts in English" without focus area track specifications.

While all options share an emphasis on research and critical thinking, each provides diverse pathways for exploring culture and language. You'll hone your expertise through each concentration's core and elective curriculum. At the end of the 33-hour program, you'll fine-tune and showcase your knowledge through a capstone project.

Student Financial Support

Teaching assistantships are available for a limited number of promising students. Assistantships are awarded upon admission and are only available for full-time students who begin their graduate work in the fall semester. These students will work with an experienced faculty member during their first year in the program before teaching classes during their second year. Most TAs will teach composition in the First-Year Writing Program while a few others may teach linguistics or film studies.

Degrees

- English (MA) (p. 590)
- English (MA): Film Studies Concentration (p. 595)
- English (MA): Linguistics Concentration (p. 597)
- English (MA): Literature Concentration (p. 599)
- English (MA): Rhetoric and Composition (p. 602)
- Digital Humanities (Certificate) (p. 604)

Faculty

Christopher M. Anson

William Wilton Barnhardt

Barbara A. Bennett

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Huiling Ding

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Marsha Gabrielle Gordon

Hans Dodds Kellner

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Jason Miller

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James S. Mulholland

Miriam E. Orr

Juliana Makuchi Nfah-Abbenyi

Jeffrey Leo Reaser

Laura Ruth Severin

Jason Swarts

Erik R. Thomas

John N. Wall Jr.

Walter A. Wolfram

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Helen Jane Burgess

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Zachary Charles Beare

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Barbara Joan Baines

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James M. Grimwood

Antony Howard Harrison

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Michael P. Carter

David H. Covington

Robert S. Dicks

James W. Clark Jr.

Angela Mackie Davis-Gardner

Jack D. Durant

Joseph A. Gomez

Charlotte Gross

Linda T. Holley

Deborah Hooker

Marvin Hunt

Susan M. Katz

John J. Kessel

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Lucinda H. MacKethan

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Carmine A. Prioli

Dick J. Reavis

Sharon M. Setzer

Judy Jo Small

Lee Smith

Jean J. Smoot

Allen Frederick Stein

Jon F. Thompson

Mary Helen Thuente

Robert V. Young Jr.

Catherine A. Warren

Harry C. West

English (MA)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Focus Tracks are as follows:

- Film Studies (p. 590)
- Linguistics (p. 591)
- Literature (p. 591)
- Rhetoric and Composition (p. 593)

Degrees earned will be distributed as: "Master of Arts in English" without focus area track specifications.

Film Studies Track

Code	Title	Hours	Counts towards
Research Courses		**6**	
ENG 587	Interdisciplinary Studies in English [1]		
ENG 676	Master's Project in English		
Core Courses		**15**	
Select nine hours of 500-level film coursework approved in conjunction with the academic committee [2]			
Select an additional six hours of elective courses approved in conjunction with the academic committee [3]			
Department Electives		**6**	
Select six hours of coursework in Literature, Rhetoric and Composition, or Linguistics approved in conjunction with the academic committee			
Open Electives		**6**	

Select six hours of open electives in any area, including film or another area of complementary study, approved in conjunction with the academic committee [4]	
Total Hours	**33**

1 An alternative course may be selected approved in conjunction with the academic committee

2 Excluding ENG 592 Special Topics in Film Styles and Genres

3 The electives may include an additional 500-level film studies course, ENG 592 Styles and Genres (this is a dual level/upper level undergraduate course for which ENG 592 students will do graduate-level work), or ENG 636 Directed Readings (S/U graded courses).

4 Courses may also include various sections of ENG 585 Studies In Film, ENG 592 Special Topics in Film Styles and Genres, or ENG 636 Directed Readings.

Linguistics Track

Code	Title	Hours	Counts towards
Distribution Requirement Courses		**6**	
Select six credit hours of coursework in Literature, Film, or Rhetoric and Composition approved in conjunction with the academic committee			
Linguistics Track Courses		**24**	
Linguistics Courses			
Select a minimum of five Linguistics courses approved in conjunction with the academic committee			
Elective Courses			
Select a minimum of three courses from English or complementary fields of study approved in conjunction with the academic committee			
Research Course		**3**	
ENG 676	Master's Project in English		
Total Hours		**33**	

Literature Track

Code	Title	Hours	Counts towards
Research Component Courses		**6**	
ENG 669	Literature, Methods, and the Profession [5]		
ENG 676	Master's Project in English [6]		
Distribution Requirement Courses		**12**	
Select one course from each of the following four areas listed under "Distribution Requirement Courses" listed below			
Literature Elective Courses		**9**	
Select three literature courses approved in conjunction with the academic committee [7]			
Open Elective Courses		**6**	
Select two elective courses in English or complementary fields of study approved in conjunction with the academic committee [8]			
Global Perspective Requirement (Co-Requisite)			
See "Global Perspective Requirement" for details below			
Total Hours		**33**	

5 ENG 669 is required in the first semester

6 ENG 676 is required in the final semester

7 Students may elect to explore broadly or to focus their coursework in an area of special interest.

8 Electives may be chosen from English or from complementary fields of study. TAs may count ENG 624 as an elective.

Distribution Requirement Courses

Select one course from each of the following areas listed below:

British Literature before 1600

Code	Title	Hours	Counts towards
ENG 509	Old English Literature		
ENG 510	Middle English Literature		
ENG 529	16th-Century Non-Dramatic English Literature		
ENG 551	Chaucer		
ENG 558	Studies In Shakespeare		
ENG 561	Milton		
ENG 578	English Drama To 1642		
ENG 582	Studies in Literature (when topic applies)		

British Literature after 1600

Code	Title	Hours	Counts towards
ENG 550	British Romantic Period		
ENG 560	British Victorian Period		
ENG 562	18TH-Century English Literature		

ENG 563	18TH-Century English Novel
ENG 564	Victorian Novel
ENG 570	20TH-Century British Prose
ENG 571	20TH-Century British Poetry
ENG 572	Modern British Drama
ENG 579	Restoration and 18th-Century Drama
ENG 582	Studies in Literature

American Literature

Code	Title	Hours	Counts towards
ENG 531	American Colonial Literature		
ENG 548	African-American Literature		
ENG 555	American Romantic Period		
ENG 565	American Realism and Naturalism		
ENG 573	Modern American Drama		
ENG 575	Southern Writers		
ENG 576	20TH-Century American Poetry		
ENG 577	20th-Century American Prose		
ENG 580	Literary Postmodernism		
ENG 582	Studies in Literature		

Rhetoric, Linguistics, Composition, Film Studies, Criticism or Theory

Code	Title	Hours	Counts towards
ENG 505	Writing Program Administration: Theory, Practice, and Research		
ENG 511	Theory and Research In Composition		
ENG 513	Empirical Research In Composition		
ENG 514	History Of Rhetoric		
ENG 515	Rhetoric Of Science and Technology		
ENG 516	Rhetorical Criticism: Theory and Practice		
ENG 523	Language Variation Research Seminar		
ENG 524	Introduction to Linguistics		
ENG 525	Variety In Language		
ENG 528	Sociophonetics		
ENG 532	Narrative Analysis		
ENG 533	Bilingualism and Language Contact		
ENG 534	Quantitative Analysis in Sociolinguistics		
ENG 536	Research Methods in Phonology		
ENG 539	Seminar In World Literature		
ENG 540	History Of Literary Criticism		
ENG 541	Literary and Cultural Theory		
ENG 549	Modern African Literature		
ENG 554	Contemporary Rhetorical Theory		
ENG 580	Literary Postmodernism		
ENG 581	Visual Rhetoric: Theory and Criticism		
ENG 582	Studies in Literature		
ENG 583	Studies In Rhetoric and Writing		
ENG 584	Studies In Linguistics		
ENG 586	Studies In Theory		

Global Perspective Requirement

The Global Perspectives requirement is intended to provide students with a greater understanding of language structure and a globalizing perspective on texts and culture. Student may fulfill this requirement in one of two ways:

1. Demonstrate language proficiency (by meeting one of the following options):
   a. Taking a reading exam administered by the Department of Foreign Languages and Literatures. The Foreign Language Department offers optional preparatory courses for students

planning to take the reading exam: FLS 401 Spanish Graduate Reading, FLF 401 French Graduate Reading, FLG 401 German Graduate Reading.

b. Enrolling in and passing with a C- or better a 300-400 level course taught in the language (not translation).*

c. Having an undergraduate major or minor in a foreign language within the past five years.*

d. Speaking a language other than English as your first language.*

2. Take a World Literature course or an approved alternative. This course will typically count toward the degree as a literature or unrestricted elective, but there may be some instances in which the course can fulfill a core requirement.

If you're considering doctoral work in literary study, we encourage you to consult with your advisor. In some cases, certifying language proficiency via reading exam may help satisfy a doctoral language requirement later on.

* *To document language proficiency via option B, C or D, contact the Graduate Services Coordinator.*

Rhetoric and Composition Track

Code	Title	Hours	Counts towards
Core Courses		**15**	
Composition			
ENG 511	Theory and Research In Composition		
Rhetoric Course			
Select one of the following courses listed under "Rhetoric Courses" listed below			
Rhetoric and Composition Courses			
Select two courses from "Rhetoric Courses" or "Research Component Courses" listed below [9]			
Linguistics Course			
Select a Linguistics course approved in conjunction with the academic committee [10]			
Research Component Course		**6**	
Select one additional course from "Research Component Courses" listed below			
ENG 676	Master's Project in English [11]		
Department Electives		**6**	
Select six credit hours of coursework in Literature, Rhetoric and Composition, or Linguistics approved in conjunction with the academic committee			
Open Elective Courses		**6**	
Select two elective courses approved in conjunction with the academic committee [12]			
Total Hours		**33**	

[9] May include special topics courses in areas such as computers and composition, emerging genres, writing across the curriculum, and writing program administration (usually offered as ENG 583 Studies In Rhetoric and Writing.

[10] ENG 525 Variety In Language is recommended if you are planning a teaching career. Note: If you choose a linguistics course to fulfill your research methods requirement (e.g., ENG 527 Discourse Analysis), you may take an additional rhetoric or composition elective in this slot instead.

[11] The capstone project should be on a topic that draws from scholarship in the area of rhetoric and composition or that is of clear relevance in the field. It should be conceived to address a specific audience and designed for a specific situation; thus, it could be composed as an article targeting a specific journal or conference; a curriculum plan or teaching materials for a particular instructional agenda; an online resource fulfilling a well defined need; etc. The master's project should be developed in consultation with faculty in rhetoric and composition and must be approved by the advisor for the concentration.

[12] "Open Elective Courses" may be from rhetoric and composition, linguistics, literature, digital humanities or other areas within the English Department, or, when appropriate to meet particular goals, from the Department of Communication, Foreign Languages, History, Psychology, the College of Education, or other fields.

Rhetoric Courses

These courses address major issues and concepts in rhetoric ranging from Greek antiquity to contemporary poststructuralism, and applications from public speeches to popular culture to teaching to technical communication.

Code	Title	Hours	Counts towards
Select one of the following courses:			
ENG/COM 514	History Of Rhetoric		
ENG 515	Rhetoric Of Science and Technology		
ENG/COM 516	Rhetorical Criticism: Theory and Practice		
ENG/COM 554	Contemporary Rhetorical Theory		

Research Component Courses

Before embarking on your capstone research, select one research methods course congruent with your disciplinary interests.

Code	Title	Hours	Counts towards
Select one of the following courses to fulfill the "Research Component Course" requirement:			

ENG 506	Verbal Data Analysis
ENG 513	Empirical Research In Composition
ENG/COM 516	Rhetorical Criticism: Theory and Practice
ENG 527	Discourse Analysis
ENG 532	Narrative Analysis
ENG/COM 581	Visual Rhetoric: Theory and Criticism
ENG 583	Studies In Rhetoric and Writing [13]
ENG 585	Studies In Film [14]
ENG 587	Interdisciplinary Studies in English [15]

[13] ENG 583 Studies In Rhetoric and Writing when topic is methodological

[14] ENG 585 Studies In Film when focused on pertinent methodologies

[15] ENG 587 Interdisciplinary Studies in English when focused on pertinent methodologies

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Christopher M. Anson

William Wilton Barnhardt

Barbara A. Bennett

Belle McQuaide Boggs

Eduardo C. Corral

Huiling Ding

Robin M. Dodsworth

Marsha Gabrielle Gordon

Hans Dodds Kellner

Dorianne Louise Laux

Leila S. May

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Erik R. Thomas

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Helen Jane Burgess

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Casie J. Fedukovich

Paul Camm Fyfe

Andrew Robert Johnston

Jennifer Anne Nolan

Stacey L. Pigg

David M. Rieder

Margaret Simon

Timothy Linwood Stinson

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Rebecca Ann Walsh

Zachary Charles Beare

Ronisha Witlee Browdy

Sumita Chakraborty

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Judy Jo Small

Lee Smith

Jean J. Smoot

Allen Frederick Stein

Jon F. Thompson

Mary Helen Thuente

Robert V. Young Jr.

Catherine A. Warren

Harry C. West

English (MA): Film Studies Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Research Courses		**6**	
ENG 587	Interdisciplinary Studies in English [1]		
ENG 676	Master's Project in English		
Core Courses		**15**	
Film Courses			
Select nine hours of 500-level film coursework approved in conjunction with the academic committee [2]			
Additional Courses			
Select an additional six hours of elective courses approved in conjunction with the academic committee [3]			
Department Electives		**6**	
Select six hours of coursework in Literature, Rhetoric and Composition, or Linguistics approved in conjunction with the academic committee			
Open Electives		**6**	
Select six hours of open electives in any area, including film or another area of complementary study, approved in conjunction with the academic committee [4]			
Total Hours		**33**	

1 An alternative course may be selected approved in conjunction with the academic committee

2 Excluding ENG 592 Special Topics in Film Styles and Genres

3 The electives may include an additional 500-level film studies course, ENG 592 Styles and Genres (this is a dual level/upper level undergraduate course for which ENG 592 students will do graduate-level work), or ENG 636 Directed Readings (S/U graded courses).

4 Courses may also include various sections of ENG 585 Studies In Film, ENG 592 Special Topics in Film Styles and Genres, or ENG 636 Directed Readings.

Film Courses

Code	Title	Hours	Counts towards
Select nine hours of 500-level film coursework approved in conjunction with the academic committee			
ENG 585	Studies In Film	3	
ENG 587	Interdisciplinary Studies in English	3	
ENG 591	Studies in National Cinemas	3	
ENG 592	Special Topics in Film Styles and Genres	1-6	

Faculty

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John D. Morillo

James S. Mulholland

Miriam E. Orr

Juliana Makuchi Nfah-Abbenyi

Jeffrey Leo Reaser

Laura Ruth Severin

Jason Swarts

Erik R. Thomas

John N. Wall Jr.

Walter A. Wolfram

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Lucinda H. MacKethan

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Judy Jo Small

Lee Smith

Jean J. Smoot

Allen Frederick Stein

Jon F. Thompson

Mary Helen Thuente

Robert V. Young Jr.

Catherine A. Warren

Harry C. West

English (MA): Linguistics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Distribution Requirement Courses		**6**	
Select six hours of coursework in Literature, Film, or Rhetoric and Composition approved in conjunction with the academic committee			
Concentration Requirements		**24**	
Linguistics Courses			
Select a minimum of five "Linguistics Courses" listed below approved in conjunction with the academic committee			
Elective Courses			
Select a minimum of three courses from English or complementary fields of study approved in conjunction with the academic committee			
Research Course		**3**	
ENG 676	Master's Project in English		
Total Hours		**33**	

Linguistics Courses

Code	Title	Hours	Counts towards
Select a minimum of five "Linguistics Courses" approved in conjunction with the academic committee			
ENG 523	Language Variation Research Seminar	3	
ENG 524	Introduction to Linguistics	3	
ENG 525	Variety In Language	3	
ENG 527	Discourse Analysis	3	
ENG 528	Sociophonetics	3	
ENG 533	Bilingualism and Language Contact	3	
ENG 534	Quantitative Analysis in Sociolinguistics	3	
ENG 536	Research Methods in Phonology	3	

ENG 584	Studies In Linguistics	3

Faculty

Christopher M. Anson

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Catherine A. Warren

Harry C. West

English (MA): Literature Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Research Component Courses		**6**	
ENG 669	Literature, Methods, and the Profession [1]		
ENG 676	Master's Project in English [2]		
Distribution Requirement Courses		**12**	
Select one course from each of the following four areas listed under "Distribution Requirement Courses" listed below			
Literature Elective Courses		**9**	
Select three literature courses approved in conjunction with the academic committee [3]			
Open Elective Courses		**6**	
Select two elective courses in English or complementary fields of study approved in conjunction with the academic committee [4]			
Global Perspective Requirement (Co-Requisite)			
See "Global Perspective Requirement" for details below			
Total Hours		**33**	

1. ENG 669 is required in the first semester
2. ENG 676 is required in the final semester
3. Students may elect to explore broadly or to focus their coursework in an area of special interest.
4. Electives may be chosen from English or from complementary fields of study. TAs may count ENG 624 as an elective.

Distribution Requirement Courses

Select one course from each of the following areas listed below:

British Literature before 1600

Code	Title	Hours	Counts towards
ENG 509	Old English Literature	3	
ENG 510	Middle English Literature	3	
ENG 529	16th-Century Non-Dramatic English Literature	3	
ENG 551	Chaucer	3	
ENG 558	Studies In Shakespeare	3	
ENG 561	Milton	3	
ENG 578	English Drama To 1642	3	
ENG 582	Studies in Literature (when topic applies)	3	

British Literature after 1600

Code	Title	Hours	Counts towards
ENG 550	British Romantic Period	3	
ENG 560	British Victorian Period	3	
ENG 562	18TH-Century English Literature	3	
ENG 563	18TH-Century English Novel	3	
ENG 564	Victorian Novel	3	
ENG 570	20TH-Century British Prose	3	
ENG 571	20TH-Century British Poetry	3	
ENG 572	Modern British Drama	3	

ENG 579	Restoration and 18th-Century Drama	3
ENG 582	Studies in Literature	3

American Literature

Code	Title	Hours	Counts towards
ENG 531	American Colonial Literature	3	
ENG 548	African-American Literature	3	
ENG 555	American Romantic Period	3	
ENG 565	American Realism and Naturalism	3	
ENG 573	Modern American Drama	3	
ENG 575	Southern Writers	3	
ENG 576	20TH-Century American Poetry	3	
ENG 577	20th-Century American Prose	3	
ENG 580	Literary Postmodernism	3	
ENG 582	Studies in Literature	3	

Rhetoric, Linguistics, Composition, Film Studies, Criticism or Theory

Code	Title	Hours	Counts towards
ENG 505	Writing Program Administration: Theory, Practice, and Research	3	
ENG 511	Theory and Research In Composition	3	
ENG 513	Empirical Research In Composition	3	
ENG 514	History Of Rhetoric	3	
ENG 515	Rhetoric Of Science and Technology	3	
ENG 516	Rhetorical Criticism: Theory and Practice	3	
ENG 523	Language Variation Research Seminar	3	
ENG 524	Introduction to Linguistics	3	
ENG 525	Variety In Language	3	
ENG 528	Sociophonetics	3	
ENG 532	Narrative Analysis	3	
ENG 533	Bilingualism and Language Contact	3	
ENG 534	Quantitative Analysis in Sociolinguistics	3	
ENG 536	Research Methods in Phonology	3	
ENG 539	Seminar In World Literature	3	
ENG 540	History Of Literary Criticism	3	
ENG 541	Literary and Cultural Theory	3	
ENG 549	Modern African Literature	3	
ENG 554	Contemporary Rhetorical Theory	3	
ENG 580	Literary Postmodernism	3	
ENG 581	Visual Rhetoric: Theory and Criticism	3	
ENG 582	Studies in Literature	3	
ENG 583	Studies In Rhetoric and Writing	3	
ENG 584	Studies In Linguistics	3	
ENG 586	Studies In Theory	3	

Global Perspective Requirement

The Global Perspectives requirement is intended to provide students with a greater understanding of language structure and a globalizing perspective on texts and culture. Student may fulfill this requirement in one of two ways:

1. Demonstrate language proficiency (by meeting one of the following options):
   a. Taking a reading exam administered by the Department of Foreign Languages and Literatures. The Foreign Language Department offers optional preparatory courses for students planning to take the reading exam: FLS 401 Spanish Graduate Reading, FLF 401 French Graduate Reading, FLG 401 German Graduate Reading.
   b. Enrolling in and passing with a C- or better a 300-400 level course taught in the language (not translation).*
   c. Having an undergraduate major or minor in a foreign language within the past five years.*
   d. Speaking a language other than English as your first language.*

2. Take a World Literature course or an approved alternative. This course will typically count toward the degree as a literature or unrestricted elective, but there may be some instances in which the course can fulfill a core requirement.

If you're considering doctoral work in literary study, we encourage you to consult with your advisor. In some cases, certifying language proficiency via reading exam may help satisfy a doctoral language requirement later on.

* *To document language proficiency via option B, C or D, contact the Graduate Services Coordinator.*

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English (MA): Rhetoric and Composition

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
Composition			
ENG 511	Theory and Research In Composition		
Rhetoric Course			
Select one of the following courses listed under "Rhetoric Courses" listed below			
Rhetoric and Composition Courses			
Select two courses from "Rhetoric Courses" or "Research Component Courses" listed below [1]			
Linguistics Course			
Select a Linguistics course approved in conjunction with the academic committee [2]			
Research Component Course		**6**	
Select one additional course from "Research Component Courses" listed below			
ENG 676	Master's Project in English [3]		
Department Electives		**6**	
Select six credit hours of coursework in Literature, Rhetoric and Composition, or Linguistics approved in conjunction with the academic committee			
Open Elective Courses		**6**	
Select two elective courses approved in conjunction with the academic committee [4]			
Total Hours		**33**	

1 May include special topics courses in areas such as computers and composition, emerging genres, writing across the curriculum, and writing program administration (usually offered as ENG 583 Studies In Rhetoric and Writing.

2 ENG 525 Variety In Language is recommended if you are planning a teaching career. Note: If you choose a linguistics course to fulfill your research methods requirement (e.g., ENG 527 Discourse Analysis), you may take an additional rhetoric or composition elective in this slot instead.

3 The capstone project should be on a topic that draws from scholarship in the area of rhetoric and composition or that is of clear relevance in the field. It should be conceived to address a specific audience and designed for a specific situation; thus, it could be composed as an article targeting a specific journal or conference; a curriculum plan or teaching materials for a particular instructional agenda; an online resource fulfilling a well defined need; etc. The master's project should be developed in consultation with faculty in rhetoric and composition and must be approved by the advisor for the concentration.

4 "Open Elective Courses" may be from rhetoric and composition, linguistics, literature, digital humanities or other areas within the English Department, or, when appropriate to meet particular goals, from the Department of Communication, Foreign Languages, History, Psychology, the College of Education, or other fields.

Rhetoric Courses

These courses address major issues and concepts in rhetoric ranging from Greek antiquity to contemporary poststructuralism, and applications from public speeches to popular culture to teaching to technical communication.

Code	Title	Hours	Counts towards
Select one of the following courses:			
ENG/COM 514	History Of Rhetoric	3	
ENG 515	Rhetoric Of Science and Technology	3	
ENG/COM 516	Rhetorical Criticism: Theory and Practice	3	
ENG/COM 554	Contemporary Rhetorical Theory	3	

Research Component Courses

Before embarking on your capstone research, select one research methods course congruent with your disciplinary interests.

Code	Title	Hours	Counts towards
Select one of the following courses to fulfill the "Research Component Course" requirement:			
ENG 506	Verbal Data Analysis	3	
ENG 513	Empirical Research In Composition	3	
ENG/COM 516	Rhetorical Criticism: Theory and Practice	3	
ENG 527	Discourse Analysis	3	
ENG 532	Narrative Analysis	3	
ENG/COM 581	Visual Rhetoric: Theory and Criticism	3	
ENG 583	Studies In Rhetoric and Writing [5]	3	
ENG 585	Studies In Film [6]	3	
ENG 587	Interdisciplinary Studies in English [7]	3	

[5] ENG 583 Studies In Rhetoric and Writing when topic is methodological

[6] ENG 585 Studies In Film when focused on pertinent methodologies

[7] ENG 587 Interdisciplinary Studies in English when focused on pertinent methodologies

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Digital Humanities (Certificate)

The Certificate in Digital Humanities is a designed for students from any discipline to construct a curriculum in digital humanities training and project work. The certificate is currently coordinated in the English department with participation across CHASS and other colleges.

The Graduate Certificate consists of a student-proposed curriculum of four 3-credit courses which must collectively satisfy the program's three requirements: contexts, training, and applications. In consultation with the coordinator, students can propose their own tracks through the certificate drawing from a broad array of approved courses at NC State as well as at UNC and Duke, as part of the Triangle Digital Humanities Network. Rather than insisting on a prescriptive definition and preset curriculum for "digital humanities," this certificate program encourages students to adapt course offerings in digital humanities or digital media to their own evolving research and professional interests in any variety of fields.

To qualify for admission to the Graduate Certificate in Digital Humanities, students must be enrolled in, or have completed, a Master's or PhD program at an accredited university. Applicants can be either non-degree or degree students. Degree students must have at the time of application a 3.00 grade point average in their graduate degree program. Non-degree students must have a final grade point average that is at least 3.00. Current degree students in English or CRDM may include no more than six (6) credits from the Certificate program in their degree program. Current degree students in History can apply up to nine (9) towards a

doctorate. Students seeking the certificate from other programs must consult with those graduate coordinators to confirm allowed credits toward degree. The certificate will accept up to three hours of transfer credit from courses included in the curriculum. All GCP requirements must be completed within three (3) calendar years beginning on the date the student commences applicable courses.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select 12 credit hours of electives: [1]			
ENG 506	Verbal Data Analysis [1]		
ENG 519	Online Information Design and Evaluation		
ENG 583	Studies In Rhetoric and Writing		
ENG 584	Studies In Linguistics		
ENG 587	Interdisciplinary Studies in English		
CRD 702	Rhetoric and Digital Media		
HI 534	Theory and Practice of Digital History		
HI 535	Spatial History		
HI 599	Independent Study		
COM 537	Gaming and Social Networks		
COM 547	Mobile Media and Communication		
COM 598	Special Topics In Communication (Internet and Society)		
ADN 419	Creative Technology Studio I [2]		
ADN 423	Digital Modeling		
ADN 502	Graduate Art + Design Laboratory		
ADN 561	Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation [3]		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 546	New Literacies & Media		
ECI 717	Advanced Multimedia Design and Applications in Instruction [4]		
Total Hours		**12**	

1. Additional courses available at UNC Chapel Hill
2. Prerequisites in the College of Design: ADN 419 Creative Technology Studio I requires D105 and ADN 219 Digital Imaging I
3. Prerequisites in the College of Design: ADN 561 Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation requires ADN 460 Creative Technology Studio II and ADN 419 Creative Technology Studio I.
4. Prerequisite: ECI 511 Introduction to Learning Design and Technology, ECI 514 Developing and Delivering Online Instruction

Foreign Language and Literature

The Master's degree in Foreign Languages and Literature offers concentrations in both French Language and Literature and Spanish Language and Literature.

Admission Requirements

- A baccalaureate degree from an accredited college or university
- Undergraduate GPA of 3.0 or above
- Narrative statement of professional and personal objectives (in English, 300 words).
- Language proficiency as determined by a writing sample and a speaking sample in the target language (French or Spanish)
- Some applicants may be given provisional admittance. Students admitted provisionally must complete at least 9 hours of 500-level courses in the target language, earning grades of B or higher in order to receive full graduate standing.

Degree Requirements

The program requires at least 30 hours of course work and a culminating project. Each student's program is tailored to enhance his or her career objectives. Students who plan to pursue a Ph.D. or teach in a community college or university receive the requisite training and assistance.
K-12 teachers who already have "Initial" or "A" licensure may earn "M" licensure by taking 30 hours in specified disciplines and completing an Action Research Project as their culminating project. K-12 teachers who already hold "A" licensure can add-on English as a Second Language (ESL) licensure by taking 36 hours in specified disciplines.

Student Financial Support

Graduate assistantships are available to students in both the French and Spanish concentrations and are awarded by open competition and based on the strength of the admissions application.

Other Relevant Information

Students are admitted for the fall semester only. February 1 is the application deadline for students interested in receiving full consideration for a teaching assistantship. (Interest is indicated on the Graduate School Admissions application.) February 15 is the deadline for international students and May 1 for domestic students.

Degrees

- Foreign Language and Literature (MA): French Language and Literature Concentration (p. 606)
- Foreign Language and Literature (MA): Spanish Language and Literature Concentration (p. 607)
- Foreign Language and Literature (MA): Teaching of English to Speakers of Other Languages (TESOL) Concentration (p. 609)

Faculty

Full Professors

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Jorge Mari

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Foreign Language and Literature (MA): French Language and Literature Concentration

Master of Art Degree Requirements

Code	Title	Hours	Counts towards
Core Courses *		**9**	
FLF 520	Approaches to Literary Theory and Culture		
FL 507	College Teaching of Foreign Languages		
FLF 675	Special Project in French		
Elective Courses		**21**	
Select at least a minimum of four of the following:			
FLF 502	Variety in Language: French		
FLF 511	Approaches to French Translation		
FLF 521	French Cultures and Contexts		

FLF 525	Literature, Cinema and Culture of the Francophone World	
FLF 592	Seminar in French Studies	
FLF 595	Special Topics in French	
Additional elective courses are approved in conjunction with the academic committee to meet the 30 total credit hours		
Total Hours		**30**

* Only FLF 520%7CCode and FLF 675%7CCode are required for the degree; FL 507%7CCode is also required of GTAs.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Foreign Language and Literature (MA): Spanish Language and Literature Concentration

Master of Art Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
FLS 502	Linguistic Structure of Spanish		
FLS 520	Survey of Hispanic Literature and Culture		
FL 507	College Teaching of Foreign Languages		
FLS 675	Special Project in Spanish		
Elective Courses		**18**	
Select a minimum of three of the following courses:			
FLS 503	Spanish Applied Linguistics		

FLS 504	Spanish Language Change and Variation	
FLS 509	Spanish Phonetics and Phonology	
FLS 512	Spanish in the United States	
FLS 515	History of Spanish Language	
FLS 528	Don Quixote	
FLS 530	The Cultural Production of Spanish Democracy	
FLS 545	Spanish Environmental Cultural Studies	
FLS 553	The Latin American Avant-Garde	
FLS 554	The Sixties in Latin America	
FLS 563	The Latin American Novel	
FLS 592	Seminar in Hispanic Studies	
FLS 595	Special Topics in Spanish	
Additional elective courses are approved in conjunction with the academic committee to meet the 30 total credit hours		
Total Hours		**30**

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Mary Ann Witt

Foreign Language and Literature (MA): Teaching of English to Speakers of Other Languages (TESOL) Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
FL 524	Linguistics for ESL Professionals		
FL 527	Methods and Materials in Teaching English as a Second Language		
FL 535	Teaching Academic Writing to Multilingual Learners		
FL 536	Perspectives on English as a New Language		
FL 595	Special Topics in Foreign Languages and Literatures		
Select one of the following sequences:			
FL 505 & FL 508	Issues and Trends in Foreign Language Education: Theory & Practice and Second Language Acquisition Research: Interlanguage Development		
FL 507 & FL 508	College Teaching of Foreign Languages and Second Language Acquisition Research: Interlanguage Development		
Elective Courses		**12**	
"Elective Courses" are approved in conjunction with the academic committee			
Total Hours		**30**	

History

Admission Requirements

Admission to the M.A. in History and Public History programs require: a bachelor's degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages. Admission to the Ph.D. in Public History requires a bachelor's degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages.

Master's Degree Requirements

Master of Arts Degree in History: This program requires a total of 30 credit hours, including 6 hours in core courses, 12 credit hours in a major field, 6 credit hours in a minor field, and 6 credit hours in thesis work. Each student's program is tailored to enhance his or her career objectives. Social studies teachers, for example, may earn advanced competency on completion of the M.A. in history with additional course work in education. Similarly, students who plan to pursue a Ph.D. degree receive the requisite training and assistance. Master of Arts Degree in Public History: This program requires 36 credit hours of course work. Students may take a non-thesis or thesis option. Half the hours fall in historical studies, the rest in applied history classes, including innovative courses in museum studies and heritage studies. Students perform internships in their own special areas of interest.

Doctoral Degree Requirements

The Ph.D. program in Public History requires 72 credit hours. Students complete 21 credit hours in a public history field, including an internship; 21 credit hours in a history field; 6 credit hours in an outside field; and 24 credit hours of dissertation work.

Student Financial Support

Graduate teaching assistantships are available to students in all programs and are awarded by open competition.

Other Relevant Information

The application deadline for fall semester is January 15; students are admitted for the fall semester only.

Degrees

- History (MA) (p. 610)
- History (Minor) (p. 613)

Faculty

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Xiaolin Duan

Ebony Jones

Tate Paulette

Emeritus Faculty

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Owen J. Kalinga

John M. Riddle

Richard Wayne Slatta

Stephanie Laine Spencer

Gerald Surh

Lecturer

Gwyneth Anne Thayer

History (MA)

Master of Art Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
HI 597	Historiography and Historical Method		
HI 598	Historical Writing		
Primary Field Courses		**12**	
Select a minimum of four courses of 500-level or above courses approved in conjunction with the academic committee			
Secondary Field Courses		**6**	
Select a minimum of three courses other than those used to fulfill the "Primary Field Courses" approved in conjunction with the academic committee			
Thesis Research Course		**6**	
HI 695/699	Master's Thesis Research		
Total Hours		**30**	

Primary, Secondary, and Thesis Prep Courses

Code	Title	Hours	Counts towards
Primary & Secondary Field Courses			
HI 500	Civilization of the Ancient Near East	3	
HI 502	Early Christianity to the Time of Eusebius	3	
HI 503	Ancient Greek Civilization	3	
HI 504	Rome to 337 A.D.	3	
HI 505	History and Archaeology of the Roman Empire	3	
HI 506	From Roman Empire to Middle Ages	3	
HI 507	Islamic History to 1798	3	
HI 508	Islam in the Modern World	3	

HI 509	The High Middle Ages	3
HI 511	Trials of Faith: Religious Reformation in Early-Modern Europe	3
HI 512	The Sexes and Society in Early-Modern Europe	3
HI 514	From Kings to Revolution: The History of Early-Modern France	3
HI 515	The French Revolution	3
HI 518	Fascist Italy and Nazi Germany	3
HI 519	Modern European Imperialism	3
HI 521	European Intellectual History: The Eighteenth Century	3
HI 522	European Intellectual History: The 19th Century	3
HI 523	Women in European Enlightenment	3
HI 525	Tudor and Stuart England	3
HI 530	Modern France	3
HI 533	Theory and Practice of Oral History	3
HI 534	Theory and Practice of Digital History	3
HI 535	Spatial History	3
HI 539	History Of the Soviet Union and After	3
HI 540	American Environmental History	3
HI 541	Colonial and Revolutionary U.S	3
HI 543	U.S. Constitutional History to 1883	3
HI 544	US Constitutional History Since 1870	3
HI 545	Early American Borderlands	3
HI 546	Topics in Civil War and Reconstruction	3
HI 547	Women in America: From Contact to the Civil War	3
HI 548	American Women in the Twentieth Century	3
HI 549	U.S. Labor to 1900	3
HI 550	U. S. Labor Since 1900	3
HI 551	The Vietnam War	3
HI 552	Recent America	3
HI 553	United States-Latin American Relations Since 1823	3
HI 554	History Of U. S. Foreign Relations, 1900-Present	3
HI 555	History of the Civil Rights Movement	3
HI 559	The Early American Republic	3
HI 561	Civilization of the Old South	3
HI 562	Southern History since the Civil War	3
HI 563	Topics in History and Memory	3
HI 566	Readings in Native American History	3
HI 568	Slavery in the Americas	3
HI 569	Latin American Revolutions	3
HI 570	Exploring World History	3
HI 571	Revolutionary China	3
HI 572	The Rise of Modern Japan, 1850-Present	3
HI 573	Japan's Empire in Asia, 1868-1945	3

HI 575	History of the Republic of South Africa	3
HI 576	Leadership in Modern Africa	3
HI 578	Islam and Christianity in Sub-Saharan Africa since the 19th Century	3
HI 579	Africa (sub-Saharan) in the Twentieth Century	3
HI 581	History of the Life Sciences	3
HI 582	Darwinism in Science and Society	3
HI 583	Science and Religion in European History	3
HI 584	Science in European Culture	3
HI 585	History of American Technology	3
HI 586	Science and Empire	3
HI 587	Cultural Resource Management	3
HI 588	Family and Community History	3
HI 589	Interpretation in Historic Sites and Parks	3
HI 591	Museum Studies	3
HI 593	Material Culture	3
HI 594	Cultural Heritage	3
HI 595	Special Topics in History	1-6
HI 596	Introduction To Public History	3
HI 599	Independent Study	1-3
HI 642	Internship In Public History	3
Thesis Prep Courses		
HI 685	Master's Supervised Teaching	1-3
HI 693	Master's Supervised Research	1-9
HI 695	Master's Thesis Research	1-9
HI 696	Summer Thesis Research	1
HI 699	Master's Thesis Preparation	1-9
HI 787	African American Public History	3
HI 788	Native American Public History	3
HI 789	Public History in International Context	3
HI 791	Colloquium in Public History	3
HI 792	Colloquium in History	3
HI 795	Special Topics	1-6
HI 799	Independent Study	1-3
HI 885	Doctoral Supervised Teaching	1-3
HI 889	Doctoral Dissertation Seminar	1
HI 895	Doctoral Dissertation Research	1-9
HI 896	Summer Dissert Res	1
HI 899	Doctoral Dissertation Preparation	1-3

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

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Faculty

Full Professors

William Adler

David R. Ambaras

Ross Knox Bassett

Craig T. Friend

David P. Gilmartin

Holly Hurlburt

Akram F. Khater

Mi Gyung Kim

Keith Phillip Luria

Anne W. Mitchell

Samuel Thomas Parker III

Julia Rudolph

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Matthew Morse Booker

M. L. Cherry

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William Charles Kimler

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Gerald Surh

Lecturer

Gwyneth Anne Thayer

History (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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International Studies

The Master of International Studies (MIS) is a 36 credit, non-thesis professional degree program that prepares students for careers in government service, non-profit administration, international business, and international student services and study abroad. Located in the School of Public and International Affairs, the MIS degree draws upon faculty and courses from colleges and departments across the university. Approximately half of the course work for the degree is devoted to developing international knowledge and competencies. The remaining coursework is comprised of regional, topical, professional or technical specializations designed by students in consultation with their faculty advisors. The program has an excellent internship program that contributes to job placement upon graduation.

Admission Requirements

Applicants must provide GRE scores and a current resume in addition to other application materials required by the Graduate School.

Degree Requirements

The requirements for the MIS degree are as follows:

1. 36 credit hours of course work;
2. Core Curriculum (15 hours). One course from each of the following five groups:
   Group A - International Relations
   Group B - Comparative Politics/Societies
   Group C - International Law and Organization
   Group D - International Economy/Development
   Group E - Research Methods
3. Individualized specialization (12-15 hours). The specialization may be in a geographical region (e.g., Europe, Latin America), an international topic (e.g., security, global governance, sustainable development), a professional field (e.g., public administration, non-profit management), or a technical specialty (e.g., Geographic Information System-GIS);
4. Capstone seminar (3 hours) and oral presentation of work to faculty and peers;
5. International experience or study abroad; and
6. Competency in a foreign language as determined by the Department of Foreign Languages and Literatures (FLL).

Degrees

- International Studies (MR) (p. 615)
- International Studies (Minor) (p. 617)

Faculty

Full Professors

Frederick Willis Cubbage

Dennis M. Daley

Melissa A. Johnson

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Chia yueh Liao

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Mary Ann Witt

International Studies (MR)

Master of International Studies Degree Requirements

Students may choose from a specialization to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of International Studies" without specialization specifications.

Code	Title	Hours	Counts towards
Core Courses		**18**	
PS 571	Research Methods and Analysis (or equivalent/ or 2 GIS courses)		
MIS 601	Colloquium in International Studies		
Select one of the following:			
PS 530	Seminar In International Relations		
PS 533	Global Problems and Policy		
HI 554	History Of U. S. Foreign Relations, 1900-Present		
Select one of the following:			
PS 540	Seminar In Comparative Politics		
PS 541	Political Islam		
PS 542	European Politics		
PS 543	Seminar in Latin American & Caribbean Politics		
PS 545	Comparative Systems of Law and Justice		
PS 546	The Politics of East Asia		
PS 547	Russian Politics		
Select one of the following:			
PS 531	International Law		
PS 532	Seminar in Global Governance		
PS 536	Global Environmental Law and Policy		
Select one of the following:			
ECG 540	Economic Development		

ECG 548	International Economics	
PS 539	International Political Economy	
Specialization Courses		**18**
Select a specialization approved in conjunction with the academic committee		
Total Hours		**36**

Accelerated Bachelor's/Master's Degree Requirements

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Mary Ann Witt

International Studies (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Liberal Studies

The Master of Arts in Liberal Studies (MALS) program is an interdisciplinary graduate program administered by the College of Humanities and Social Sciences. This is a broad, interdisciplinary program of part-time or full-time graduate study that integrates and expands the student's knowledge and awareness and that is geared to the student's personal interests. Each student, in consultation with an academic advisor, designs an individual program of study around an interdisciplinary theme or topic that is of intrinsic interest to the student or that relates to the student's professional or vocational interests. Students take graduate courses across a range of NC State departments as well as MALS seminars designed specifically for the program.

Admissions Requirements

Students entering the Master's program in liberal studies must have an undergraduate degree. In addition to the material required by the Graduate School, students applying are asked to submit a four to five page statement describing their objectives in doing a degree in liberal studies and a resume. GRE scores are not required. All applicants are interviewed.

Master's Degree Requirements

Thirty hours of course work made up of:

1. three MALS seminars or two MALS seminars and a research methods course,
2. 18 hours representing the student's interdisciplinary theme or concentration, and
3. a three-hour culminating project.

Examples of concentrations that are well supported by graduate courses in the NC State curriculum are: science, technology and society, the American experience and leadership.

Degrees

- Liberal Studies (MA) (p. 619)
- Liberal Studies (Minor) (p. 620)

Faculty

Full Professors

Kimberly I. Allen

Carolyn Bird

Jonathan D. Bohlmann

Jeffrey P. Braden

Richard M. Clerkin

Gary L. Comstock

Michael D. Garval

Douglas John Gilla

Nora Haenn

Jessica K. Jameson

Akram F. Khater

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Veljko Dubljevic

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Charles Albert Flink

Jonathan Kramer

Seth Murray

Elizabeth Nelson

Lecturer

Victoria Ralston

Emeritus Faculty

Sarah Stein

Liberal Studies (MA)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
MLS 501	Seminar In Liberal Studies		
MLS 501	Seminar In Liberal Studies		
Select one of the following:			
MLS 501	Seminar In Liberal Studies		
Research Methods course across all departments approved in conjunction with the academic committee			
Concentration Courses		**6**	
Select an interdisciplinary concentration approved in conjunction with the academic committee		1	
Additional Courses		**12**	
"Additional Courses" are approved in conjunction with the academic committee to meet 30 total hours			
Culminating Project Course		**3**	
MLS 676	Independent Project		
Total Hours		**31**	

[1] Must be from at least 3 different academic disciplines, no more than 2 courses from one department, at least 2 courses in CHASS. Examples of concentrations that are well supported by graduate courses in the NC State curriculum are: science, technology and society, the American experience and leadership.

Accelerated Bachelor's/Master's Degree Requirements

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Seth Murray

Elizabeth Nelson

Lecturer

Victoria Ralston

Emeritus Faculty

Sarah Stein

Liberal Studies (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Kimberly I. Allen

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Seth Murray

Elizabeth Nelson

Lecturer

Victoria Ralston

Emeritus Faculty

Sarah Stein

Philosophy & Religious Studies

Degrees

- Cognitive Science (Minor) (p. 621)

Faculty

Assistant Professors

Veljko Dubljevic

Kevin Andrew Richardson

Cognitive Science (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
PHI/PSY 525	Introduction To Cognitive Science		
Select six credit hours of the following:			
CSC 520	Artificial Intelligence I (must be outside student's degree-granting program)		
CSC 522	Automated Learning and Data Analysis		
CSC 707	Automata, Languages and Computability Theory		

CSC 720	Artificial Intelligence II	
ENG 524	Introduction to Linguistics	
ENG 584	Studies In Linguistics	
PHI 540	The Scientific Method	
PSY 500	Visual Perception	
PSY 502	Physiological Psychology	
PSY 508	Cognitive Processes	
Total Hours		**9**

Faculty

Assistant Professors

Veljko Dubljevic

Kevin Andrew Richardson

Psychology

The Department of Psychology offers five concentrations leading to the Ph.D.:

- Applied Social and Community Psychology,
- Human Factors and Applied Cognition,
- Industrial-Organizational Psychology,
- Lifespan Developmental Psychology, and
- School Psychology.

An additional master's degree program is available for School Psychology.

Admission Requirements

With the exception of the School Psychology master's degree program, admitted students enter doctoral training programs. Applicants must be graduates of accredited institutions. Although a degree in psychology is not required, applicants must demonstrate that their academic backgrounds have prepared them for doctoral training in their specialty area. A strong academic record, GRE Test Scores are optional for Lifespan Developmental Psychology and Industrial-Organizational Psychology (GRE Scores are not accepted for Applied Social and Community Psychology, Human Factors and Applied Cognition and School Psychology), and three satisfactory letters of recommendation are required for admission. Research experience is important. Match of applicants' research interests with current faculty research is an important consideration.

Master's Degree Requirements

The department offers the master's degree in school psychology; students in the other concentrations are admitted only to the doctoral program. Students completing the school psychology master's program are eligible for licensure as public school psychologists in North Carolina. The program requires a total of 60 credit hours, including two years of course work, a summer practicum program, and a full-time internship in the third year.

For students entering doctoral programs, the master's degree is awarded only in special circumstances, typically when a student in good standing chooses not to continue in the doctoral program.

Doctoral Degree Requirements

The graduate program for each doctoral student is determined in conjunction with the student's graduate advisory committee and tailored to the needs, interests, and accomplishments of the individual. Requirements vary across concentrations, but all doctoral plans of work include at least 72 credit hours.

Student Financial Support

Many graduate students receive financial support in the form of teaching or research assistantships. All admitted applicants are considered for assistantships.

Degrees

- Psychology (MS): School Psychology Concentration (p. 623)
- Psychology (PhD) (p. 625)
- Psychology (PhD): Applied Social and Community Psychology Concentration (p. 627)
- Psychology (PhD): Human Factors and Applied Cognition Concentration (p. 629)
- Psychology (PhD): Industrial-Organizational Psychology Concentration (p. 630)
- Psychology (PhD): Lifespan Developmental Psychology Concentration (p. 632)
- Psychology (PhD): School Psychology Concentration (p. 634)
- Psychology (Minor) (p. 636)

Faculty

Full Professors

Lynne Elizabeth Baker-Ward

John Charles Begeny

Jeffery P. Braden

Lori Lea Foster

Douglas John Gillan

Amy G. Halberstadt

Mary E. Haskett

Christopher Brooke Mayhorn

Anne Collins McLaughlin

Adam W. Meade

Rupert W. Nacoste

Shevaun D. Neupert

Katharine E. Stewart

Eric N. Wiebe

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Jing Feng

Daniel Gruehn

Elan Hope

Samuel B. Pond III

Kelly Lynn Sara Mulvey

Scott Andrew Stage

Laura Marie Widman

Mark A. Wilson

Assistant Professors

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Whitney Griffin

Y. He

Kate Norwalk

Patsy Anne Sibley

Vanessa V. Volpe

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Dana Kotter-Gruehn

Lindsey C. McGowen

Natalie Simona Murr

Joseph M. Simons-Rudolph

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William P. Erchul

Denis O. Gray

Thomas M. Hess

James W. Kalat

David W. Martin

Samuel B. Pond III

Frank J. Smith

Michael S. Wogalter

Mary B. Wyer

Adjunct Faculty

David B. Kaber

Psychology (MS): School Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
PSY 502	Physiological Psychology		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**43**	
See "Concentration Requirements" listed below			

Research Courses		**15**
PSY 893	Doctoral Supervised Research	
PSY 895	Doctoral Dissertation Research	
PSY 899	Doctoral Dissertation Preparation	
Total Hours		**76**

Concentration Requirements

Code	Title	Hours	Counts towards
Didactic Courses		**31**	
PSY 710	Special Topics In Psychology (Academic Assessment and Intervention for School Psychologists)		
PSY 710	Special Topics In Psychology (Schoolwide Practices to Promote Student Learning and Mental Health)		
PSY 710	Special Topics In Psychology (Supporting the Success of Diverse Students for School Psychologists)		
PSY 721	Area Seminar In School Psychology		
PSY 722	Individual Intelligence Measurement		
PSY 723	Personality Measurement (Socioemotional Assessment)		
PSY 724	Psychological Intervention I (Applied Behavior Analysis)		
PSY 725	Psychological Intervention II (Cognitive Behavior Therapy)		
PSY 727	Psychological Consultation		
PSY 792	Psychology Of Families and Parenting		
Practica & Internship Courses		**12**	
PSY 641	Psychological Clinic Practicum (Clinic + Integrated Psychological Assessment)		
PSY 641	Psychological Clinic Practicum (Initial School-based Practicum)		
PSY 841	School Psychology Practicum (Advanced Teacher-centered Services Practicum)		
PSY 651	Internship In Psychology		
Total Hours		**43**	

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David B. Kaber

Psychology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
PSY 820	Special Topics In Psychology (Ethics)		
Select three of the following courses:			
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 760	Psychometrics		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**25-35**	
See the following pages for the corresponding concentration requirements:			

Applied Social and Community Psychology Concentration (p. 627)		
Human Factors and Applied Cognition Concentration (p. 629)		
Industrial-Organizational Psychology Concentration (p. 630)		
Lifespan Developmental Psychology Concentration (p. 632)		
School Psychology Concentration (p. 634)		
Elective Courses		**16-26**
PSY 710	Special Topics In Psychology	
PSY 893	Doctoral Supervised Research	
PSY 895	Doctoral Dissertation Research	
PSY 899	Doctoral Dissertation Preparation	
Total Hours		**72**

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Psychology (PhD): Applied Social and Community Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
PSY 820	Special Topics In Psychology (Ethics)		
Select three of the following courses:			
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 760	Psychometrics		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**25**	
See "Concentration Requirements" listed below			
Elective Courses		**26**	
PSY 710	Special Topics In Psychology		
PSY 893	Doctoral Supervised Research		
PSY 895	Doctoral Dissertation Research		
PSY 899	Doctoral Dissertation Preparation		
Total Hours		**72**	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**13**	
PSY 753	Principles and Practice Of Ecological/ Community Psychology		
PSY 851	Internship In Psychology (Practicum)		
PSY 751	Intervention Planning & Evaluation		
PSY 511	Advanced Social Psychology		
PSY 809	Psychology Colloquium		
Applied Social & Community Psychology Elective Courses		**6**	
PSY 710	Special Topics In Psychology (Health Psychology)		
PSY 710	Special Topics In Psychology (Grant Writing)		
PSY 710	Special Topics In Psychology (Qualitative)		
PSY 706	Psychology of Gender		
Additional Statistics or Methods Training Courses		**6**	

Additional Statistics/Methods Training courses are determined in conjunction with the academic committee	
Total Hours	**25**

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Psychology (PhD): Human Factors and Applied Cognition Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
PSY 820	Special Topics In Psychology (Ethics)		
Select three of the following courses:			
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 760	Psychometrics		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**35**	
See "Concentration Requirements" listed below			
Elective Courses		**16**	
PSY 710	Special Topics In Psychology		
PSY 893	Doctoral Supervised Research		
PSY 895	Doctoral Dissertation Research		
PSY 899	Doctoral Dissertation Preparation		
Total Hours		**72**	

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**29**	
PSY 500	Visual Perception		
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 541	Overview of Human Factors Psychology		
PSY 704	Learning and Motivation		
PSY 743	Human Factors Methods and Measurement		
PSY 820	Special Topics In Psychology (Human Factors and Applied Cognition Colloquium)		
PSY 893	Doctoral Supervised Research		
Human Factors & Applied Cognition Elective Courses		**6**	
PSY 710	Special Topics In Psychology (Skills Acquisition)		
PSY 710	Special Topics In Psychology (Attention)		
Total Hours		**35**	

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Psychology (PhD): Industrial-Organizational Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
PSY 820	Special Topics In Psychology (Ethics)		
Select three of the following courses:			
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		

PSY 880	Directed Study In Psychology (Quantitative Methods II)	
Additional Statistics or Research Methods Course		**3**
Select one of the following courses:		
PSY 880	Directed Study In Psychology (Quantitative Methods III)	
PSY 752	Action Research In Psychology	
PSY 760	Psychometrics	
PSY 785	Methodological Issues In Developmental Psychology	
Concentration Requirements		**27**
See "Concentration Requirements" listed below		
Elective Courses		**24**
PSY 710	Special Topics In Psychology	
PSY 893	Doctoral Supervised Research	
PSY 895	Doctoral Dissertation Research	
PSY 899	Doctoral Dissertation Preparation	
Total Hours		**72**

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
PSY 760	Psychometrics		
PSY 764	Industrial Psychology		
PSY 768	Organizational Psychology I		
PSY 710	Special Topics In Psychology		
Industrial-Organizational Psychology Elective Courses		**9**	
Select a minimum of nine hours of the following courses:			
PSY 778	Organizational Psychology II		
PSY 761	Advanced Psychometrics: Item Response Theory		
PSY 766	Personnel Selection Research		
PSY 767	Training Research		
PSY 769	Work Motivation		
PSY 770	Organization Development and Change		
PSY 846	Practicum in Industrial/ Organizational Psychology		
PSY 880	Directed Study In Psychology		
PSY 710	Special Topics In Psychology		
Total Hours		**27**	

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Psychology (PhD): Lifespan Developmental Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**12**	
PSY 820	Special Topics In Psychology (Ethics)		
Select three of the following courses:			
PSY 502	Physiological Psychology		
PSY 508	Cognitive Processes		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 760	Psychometrics		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**28**	

See "Concentration Requirements" listed below		
Elective Courses		**23**
PSY 710	Special Topics In Psychology	
PSY 893	Doctoral Supervised Research	
PSY 895	Doctoral Dissertation Research	
PSY 899	Doctoral Dissertation Preparation	
Total Hours		**72**

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**22**	
PSY 584	Advanced Developmental Psychology		
PSY 785	Methodological Issues In Developmental Psychology		
PSY 786	Cognitive Development		
PSY 787	Social Development		
PSY 788	Adulthood and Aging: Cognitive and Intellectual Change		
PSY 789	Socio-Emotional Processes In Adulthood and Aging		
PSY 820	Special Topics In Psychology (Area Seminar) [1]		
Lifespan Developmental Psychology Elective Course		**6**	
PSY 502	Physiological Psychology		
PSY 880	Directed Study In Psychology (Repurposing Cognition) [2]		
Total Hours		**28**	

1 PSY 820 must be repeated four times to reach the required 4 total hours for the course.

2 PSY 880 section 103 is strongly encouraged.

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Psychology (PhD): School Psychology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
PSY 502	Physiological Psychology		
PSY 511	Advanced Social Psychology		
PSY 584	Advanced Developmental Psychology		
Quantitative Methods Courses		**6**	
PSY 880	Directed Study In Psychology (Quantitative Methods I)		
PSY 880	Directed Study In Psychology (Quantitative Methods II)		
Additional Statistics or Research Methods Course		**3**	
Select one of the following courses:			
PSY 880	Directed Study In Psychology (Quantitative Methods III)		
PSY 752	Action Research In Psychology		
PSY 785	Methodological Issues In Developmental Psychology		
Concentration Requirements		**55**	
See "Concentration Requirements" listed below			
Research Courses		**15**	
PSY 893	Doctoral Supervised Research		
PSY 895	Doctoral Dissertation Research		
PSY 899	Doctoral Dissertation Preparation		
Total Hours		**88**	

Concentration Requirements

Code	Title	Hours	Counts towards
Didactic Courses		**31**	
PSY 710	Special Topics In Psychology		
PSY 710	Special Topics In Psychology		
PSY 721	Area Seminar In School Psychology		
PSY 722	Individual Intelligence Measurement		
PSY 723	Personality Measurement		
PSY 724	Psychological Intervention I		
PSY 725	Psychological Intervention II		

PSY 727	Psychological Consultation	
PSY 792	Psychology Of Families and Parenting	
PSY 820	Special Topics In Psychology (History & Systems - Implications for School Psychologists)	
PSY 820	Special Topics In Psychology (Ethics in Psychology)	
Practica & Internship Courses		**24**
PSY 641	Psychological Clinic Practicum (Initial Practicum in Assessment)	
PSY 641	Psychological Clinic Practicum (Remainder of Required Assessment Cases)	
PSY 641	Psychological Clinic Practicum (Initial Cognitive Behavioral Therapy Practicum - Academic Counseling for Education Success)	
PSY 641	Psychological Clinic Practicum (Initial School Practicum)	
PSY 841	School Psychology Practicum (Teacher-centered Services Practicum)	
PSY 841	School Psychology Practicum (Families Practicum)	
PSY 841	School Psychology Practicum (Supervision)	
PSY 851	Internship In Psychology	
Total Hours		**55**

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Psychology (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Public Administration

Public Administration students at NC State are prepared for a career in public service. They will develop the leadership tools and knowledge they need to serve, manage and lead public or nonprofit organizations or to conduct cutting-edge academic research.

Admission Requirements

The deadline to apply to the MPA program is May 15 (March 1 for International applicants) for Fall admission and November 1 (March 1 for International applicants) for Spring admission. The deadline to apply to the Ph.D. program is March 15 (March 1 for International applicants) for Fall admission. Completed applications received by February 1 will receive consideration for all available university and department scholarships and assistantships.

Master's Degree Requirements

The MPA degree requires the completion of 42 graduate credit hours:

- 24 credit hours of core coursework
- 18 credit hours of elective coursework
- Students lacking the equivalent of one year of full-time public service experience must complete a 3 credit hour internship as part of their elective coursework.

Prerequisites for the program are an undergraduate course in microeconomics and an intermediate statistics (equivalent to ST 311) course. Students who do not have one or both of these prerequisite courses must successfully complete equivalent coursework prior to graduation. The MPA is an Option B Master's degree with a one-person committee and no final oral examination. Details on the degree requirements can be found on the Master of Public Administration (p. 638) page.

The mission of the MPA program is to develop principled and skilled public service professionals who fulfill leadership roles within governmental and nonprofit organizations. We focus on practical and problem-solving skills and emphasize public service values -- including efficiency, effectiveness, equity and accountability.

To accomplish this mission, the MPA program offers elective coursework in public management, nonprofit management, urban management, financial management, organizational leadership, public policy and justice administration.

Doctoral Degree Requirements

The Ph.D. degree requires the completion of 72 graduate credit hours:

- 60 credit hours of coursework (18 hours of relevant graduate credit from a prior Master’s degree may be used; total degree hours must include at least 36 hours at the doctoral level)
- 12 credit hours of dissertation research

Details on the degree requirements can be found on the Ph.D. in Public Administration (p. 639) page.

Each student will select or develop one or two fields of specialization.

Student Financial Support

A limited number of fellowships and graduate assistantships are offered by the Department of Public Administration. Contact the Department for more information. Other forms of student aid are described in the financial aid section of the Graduate Catalog.

Other Relevant Information

The Department of Public Administration also offers Graduate Certificates in Public Policy and Nonprofit Management, either of which can be taken alone or in conjunction with a graduate degree.

Degrees

- Public Administration (MR) (p. 638)
- Public Administration (PhD) (p. 639)
- Public Administration (Minor) (p. 640)
- Nonprofit Management (Certificate) (p. 640)
- Policy Analysis (Certificate) (p. 641)

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Public Administration (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Curriculum		**24**	
PA 510	Public Administration Institutions and Values		
PA 511	Public Policy Analysis		
PA 512	The Budgetary Process		
PA 513	Public Organization Behavior		
PA 514	Management Systems		
PA 515	Research Methods and Analysis		
PA 516	Effective Communications for Public Administrators		
PA 517	MPA Capstone		
Elective Courses		**18**	
Select eighteen credits of electives approved in conjunction with the academic committee			
Total Hours		**42**	

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Public Administration (PhD)

Degree Requirements

The Ph.D. in Public Administration requires the completion of 72 graduate credit hours, including 60 credit hours of coursework and 12 credit hours of dissertation research. Students having obtained a master's degree in a relevant discipline prior to enrollment in the PhD program may be approved for up to an 18-credit hour reduction, reducing the total to 54 graduate credit hours.

Code	Title	Hours	Counts towards
Core Courses		**24**	
PA 715	Quantitative Policy Analysis		
PA 761	Foundation of Public Administration		
PA 762	Public Organization Theory		
PA 763	Public Policy Process		
PA 765	Quantitative Research in Public Administration		
PA 766	Advanced Quantitative Research in Public Administration		
PA 798	Special Topics in Public Administration and Policy (Public Administration Research Methods and Traditions)		
PA 803	Advanced Research Design		
Management, Methods, & Specialization Courses		**6**	
Select a minimum of six credit hours of management, methods and/or content specialization courses approved in conjunction with the academic committee			
Elective Courses			
Select a minimum of one methods elective approved in conjunction with the academic committee		3	
Select an additional elective approved in conjunction with the academic committee		9	
Additional Courses		**18**	
Previous Masters Credit			
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours			
Disseration Research Course		**12**	
PA 895	Doctoral Dissertation Research		
Total Hours		**72**	

Faculty

Full Professors

Thomas A. Birkland

Richard M. Clerkin

Jerrell D. Coggburn

Dennis M. Daley

George D. Garson

Jennifer Kuzma

Branda L. Nowell

Associate Professors

Rajade M. Berry-James

James R. Brunet

Jason Alix Coupet

Jeffrey Childress Diebold

Christopher Galik

Bruce D. McDonald III

Amanda Janis Stewart

Emeritus Faculty

Michael L. Vasu

Public Administration (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Emeritus Faculty

Michael L. Vasu

Nonprofit Management (Certificate)

A Graduate Certificate in Nonprofit Management is available to students, including NC State degree students, who have a Bachelor's degree from an accredited university. The Certificate requires 15 credit hours of course work and substantive nonprofit experience. The courses are designed to provide the basic management knowledge and skills needed in nonprofit organizations.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
PA 531	Human Resource Management in Public and Nonprofit Organizations		
PA 536	Management of Nonprofit Organizations		
PA 538	Nonprofit Budgeting and Financial Management		
PA 539	Fund Development		
Select up to two of the following:		6	
PA 514	Management Systems		
PA 516	Effective Communications for Public Administrators		
PA 525	Organizational Development and Change Management		
PA 532	Contract Negotiation and Mediation in the Public and Nonprofit Sectors		
PA 540	Grant Writing for Public Administrators		
PA 546	Seminar in Program Evaluation		
COM 546	Nonprofit Marketing and Public Relations		
Total Hours		**18**	

Substantive Experience Requirement

The Substantive Experience Requirement can be met by:

- Prior (or continuing) Experience:
  - Full-time employment with a nonprofit (at least one year by completion of certificate program)
  - Serving on a nonprofit board or chairing a nonprofit's standing committee (at least one year by completion of certificate program)
- In-program Work:
  - Internship or independent study with a nonprofit (at least 1 credit hour)
  - Completing a course with a field component (e.g., PA 546 or PA 525)

Faculty

Full Professors

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Christopher Galik

Bruce D. McDonald III

Amanda Janis Stewart

Emeritus Faculty

Michael L. Vasu

Policy Analysis (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
PA 507	The Public Policy Process		
PA 509	Applied Political Economy		
PA 511	Public Policy Analysis		
Select two electives [1]			
Total Hours		**15**	

[1] Policy courses from any program - approved by coordinator

Faculty

Full Professors

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Public History

Admission Requirements

Admission to the M.A. in History and Public History programs require: a bachelor’s degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages. Admission to the Ph.D. in Public History requires a bachelor’s degree from an accredited college or university; transcripts; personal statement, listing career goals, historical interests, and potential advisor; letters of recommendation; and a writing sample of approximately ten pages.

Master's Degree Requirements

Master of Arts Degree in History: This program requires a total of 30 credit hours, including 6 hours in core courses, 12 credit hours in a major field, 6 credit hours in a minor field, and 6 credit hours in thesis work. Each student's program is tailored to enhance his or her career

objectives. Social studies teachers, for example, may earn advanced competency on completion of the M.A. in history with additional course work in education. Similarly, students who plan to pursue a Ph.D. degree receive the requisite training and assistance. Master of Arts Degree in Public History: This program requires 36 credit hours of course work. Students may take a non-thesis or thesis option. Half the hours fall in historical studies, the rest in applied history classes, including innovative courses in museum studies and heritage studies. Students perform internships in their own special areas of interest.

Doctoral Degree Requirements

The Ph.D. program in Public History requires 72 credit hours. Students complete 21 credit hours in a public history field, including an internship; 21 credit hours in a history field; 6 credit hours in an outside field; and 24 credit hours of dissertation work.

Student Financial Support

Graduate teaching assistantships are available to students in all programs and are awarded by open competition.

Other Relevant Information

The application deadline for fall semester is January 15; students are admitted for the fall semester only.

Degrees

- Public History (MA) (p. 642)
- Public History (PhD) (p. 645)
- Public History (Minor) (p. 646)

Faculty

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Blair Lynne Murphy Kelley

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Kristen Alff

Frederico Freitas

Ebony Jones

Verena Kasper-Marienberg

Judy Kertesz

Alicia McGill

Tate Sewell Paulette

Lecturer

Gwyneth Anne Thayer

Public History (MA)

Degree Requirements

Degrees earned will be distributed as: "Master of Arts in Public History" without focus area track or thesis option specifications.

Code	Title	Hours	Counts towards
Required Courses		**36**	
HI 596	Introduction To Public History		
HI 642	Internship In Public History		
HI 597	Historiography and Historical Method		
HI 598	Historical Writing		
HI 792	Colloquium in History		
Additional HI course approved in conjunction with the academic commiitee			
Core Courses and Colloquium Courses			
"Core Courses and Colloquium Courses" are approved in conjunction with the academic committee			
Focus Area Track Courses			
See "Thesis Options & Focus Area Tracks" listed below			
Elective Courses			
"Elective Courses" will be determined in conjunction with the academic committee			
Thesis Option			
See "Thesis Options & Focus Area Tracks" listed below			
Total Hours		**36**	

Thesis Options & Focus Area Tracks

Non-Thesis

Select a Focus Track Area and corresponding courses:

Code	Title	Hours	Counts towards
Select courses from one Focus Track Area below:			
Museum Studies			
HI 591	Museum Studies	3	
HI 593	Material Culture	3	
HI 588	Family and Community History	3	
or HI 589	Interpretation in Historic Sites and Parks		
or HI 787	African American Public History		
or HI 788	Native American Public History		
HI 789	Public History in International Context		
Cultural Heritage			
HI 594	Cultural Heritage	3	
HI 595	Special Topics in History	1-6	
HI 588	Family and Community History	3	
or HI 589	Interpretation in Historic Sites and Parks		
or HI 787	African American Public History		
or HI 788	Native American Public History		
Public Memory			
HI 563	Topics in History and Memory	3	
Select two of the following courses:			
HI 533	Theory and Practice of Oral History	3	
HI 534	Theory and Practice of Digital History	3	
HI 787	African American Public History	3	
HI 788	Native American Public History	3	
HI 789	Public History in International Context		
Archives and Records Management			
Select any three courses; this track must be completed as part of the credit transfer agreement with UNC SILS			

Select courses from the following list to fill the 36 total hours:

Code	Title	Hours	Counts towards
History and Public History Electives			
HI 533	Theory and Practice of Oral History	3	
HI 534	Theory and Practice of Digital History	3	
HI 535	Spatial History	3	
HI 563	Topics in History and Memory	3	
HI 587	Cultural Resource Management	3	
HI 588	Family and Community History	3	
HI 589	Interpretation in Historic Sites and Parks	3	
HI 591	Museum Studies	3	
HI 593	Material Culture	3	
HI 594	Cultural Heritage	3	
HI 595	Special Topics in History	1-6	
HI 787	African American Public History	3	
HI 788	Native American Public History	3	
HI 789	Public History in International Context		
Non-History Electives			
ANT 531	Tourism, Culture and Anthropology	3	
ANT 533	Anthropology of Ecotourism and Heritage Conservation	3	
ARC 451	Digital Representation	3	
ARC 544	American City Planning History	3	
ARC 545	Methods of Interpretation in Architectural History	3	
ARC 548	Vernacular Architecture	3	
COM 537	Gaming and Social Networks	3	
COM 546	Nonprofit Marketing and Public Relations	3	

COM 581	Visual Rhetoric: Theory and Criticism	3
NR 548	Historical Environments	3
PA 531	Human Resource Management in Public and Nonprofit Organizations	3
PA 535	Problem Solving for Public and Nonprofit Managers	3
PA 536	Management of Nonprofit Organizations	3
PA 538	Nonprofit Budgeting and Financial Management	3
PA 539	Fund Development	3
PA 540	Grant Writing for Public Administrators	3

Thesis

Code	Title	Hours	Counts towards
Required Courses		**6**	
HI 598	Historical Writing		
HI 693	Master's Supervised Research	1-9	

Code	Title	Hours	Counts towards
Select courses from one Focus Track Area below:			
Museum Studies			
HI 591	Museum Studies	3	
HI 593	Material Culture	3	
HI 588	Family and Community History	3	
or HI 589	Interpretation in Historic Sites and Parks		
or HI 787	African American Public History		
or HI 788	Native American Public History		
HI 789	Public History in International Context		
Cultural Heritage			
HI 594	Cultural Heritage	3	
HI 595	Special Topics in History	1-6	
HI 588	Family and Community History	3	
or HI 589	Interpretation in Historic Sites and Parks		
or HI 787	African American Public History		
or HI 788	Native American Public History		
Public Memory			
HI 563	Topics in History and Memory	3	
Select two of the following courses:			
HI 533	Theory and Practice of Oral History	3	
HI 534	Theory and Practice of Digital History	3	
HI 787	African American Public History	3	
HI 788	Native American Public History	3	
HI 789	Public History in International Context		
Archives and Records Management			
Select any three courses; this track must be completed as part of the credit transfer agreement with UNC SILS			

Faculty

Full Professors

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Judy Kertesz

Alicia McGill

Tate Sewell Paulette

Lecturer

Gwyneth Anne Thayer

Public History (PhD)

Degree Requirements

Students may choose from course tracks to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Public History" without focus area track specifications.

Code	Title	Hours	Counts towards
Public History Courses		**21**	
HI 596	Introduction To Public History		
HI 642	Internship In Public History		
HI 598	Historical Writing		
Select a minimum of four additional 500- to 700-level courses approved in conjunction with the academic committee [1]			
History Courses		**21**	
HI 597	Historiography and Historical Method		
HI 792	Colloquium in History [2]		
Select a minimum of three additional 500- to 700-level HI courses approved in conjunction with the academic committee			
Interdisciplinary Courses		**6**	
Select a minimum of two 500- to 800-level courses from an outside discipline approved in conjunction with the academic committee			
Dissertation Research Courses		**24**	
HI 889	Doctoral Dissertation Seminar [3]		
HI 895	Doctoral Dissertation Research [4]		
Total Hours		**72**	

1. Students can select a focus area track for to meet this requirement. Focus Area tracks include: African American History, Digital History, Heritage Studies, Museum Studies and Public Memory.
2. HI 792 must be repeated three times to meet the minimum 9-credit requirement for the course.
3. Must be taken in two consecutive semesters
4. Minimum 22 credit hours

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Alicia McGill

Tate Sewell Paulette

Lecturer

Gwyneth Anne Thayer

Public History (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Judy Kertesz

Alicia McGill

Tate Sewell Paulette

Lecturer

Gwyneth Anne Thayer

Social Work

The mission of the MSW program is to prepare students for practice that is sensitive to the social, economic, cultural, demographic and political contexts that shape our state and beyond. Within a framework emphasizing professional ethics, social justice, diversity, strengths and community engagement, the Department seeks to equip students for leadership roles and effective practice.

Admission Requirements

(scroll down to see additional requirements for Advanced Standing applicants)

- Bachelor's degree (any major) from an accredited liberal arts college or university.
- GPA of 3.0 or higher for the last 60 hours of academic work. Students with a GPA less than 3.0 but greater than 2.5 for the last 60 hours of academic course work must have official Graduate Record Exam (GRE) or Miller Analogies Test (MAT) scores forwarded to the Graduate School.
- Liberal arts coursework in the social sciences, humanities, biology, and statistics.
  - Four courses in the social sciences (e.g. anthropology, economics, ethnic studies, political science, psychology, social work, sociology), with a grade of C or better.
  - Three courses in the humanities (e.g. comparative religions, history, linguistics, literature, modern or classic languages, philosophy and ethics, visual and performing arts), with a grade of C or better.
  - A biology and a statistics course, with a grade of C or better.
- A variety of life and work experience in human services, paid or volunteer. Note: In accordance with the CSWE standards, students cannot receive academic credit based on life and work experience.

Additional Requirements for Advanced Standing

In addition to the above admissions requirements, the following applies to Advanced Standing applicants:

- Applicants with a BSW degree from an accredited program and a GPA of at least 3.5 (on a 4.0 scale) for the last 60 credit hours of academic work are eligible to apply for Advanced Standing status. Students with a GPA less than 3.5 but greater than 2.5 for the last 60 hours of academic course work must have official Graduate Record Exam (GRE) or Miller Analogies Test (MAT) scores forwarded to the Graduate School.

- BSW students who graduate prior to the first semester of Advanced Standing coursework will be considered for admission.
- Applicants must have grades of "B" or better in all social work courses.
- One of three references must be from Field/Task Supervisor or Field Director/Liaison.

Master's Degree Requirements

The MSW Program provides two options: The Traditional 60-credit program, and the 39-credit Advanced Standing Program, which is designed for BSW graduates only.

We do not offer a part-time curriculum at this time.

Other Relevant Information

The MSW program is accredited by The Council on Social Work Education (CSWE).

Degrees

- Social Work (MR) (p. 647)

Faculty

Full Professors

Karen Bullock

Maura B. Nsonwu

Associate Professors

Natalie R. Ames

Jodi K. Hall

Kim L. Stansbury

Jocelyn DeVance Warren

Intae Yoon

Assistant Professors

Gloria Thomas Anderson

Sarah Anne Ascienzo

Qiana Cryer-Coupet

Alan Reid Ellis

Social Work (MR)

Degree Requirements

Degrees earned will be distributed as: "Master of Social Work" curriculum specifications.

Traditional Curriculum

Code	Title	Hours	Counts towards
Required Coursework			
SW 501	Social Work Policy, Services and Programs	3	
SW 505	Human Behavior and the Social Environment: Social Justice	3	
SW 506	Human Behavior and the Social Environment: Individuals, Families, and Groups	3	
SW 520	SW Generalist Practice I	3	
SW 651	Social Work Field Internship I	5	
SW 510	Research Methods for Social Work	3	
SW 521	SW General Practice II	3	
SW 652	Social Work Field Internship II	5	
SW 519	Evaluation of a Social Work Intervention	2	
SW 561	Social Work Administration and Supervision	3	
SW 581	Advanced Social Work Practice with Individuals	3	
SW 653	Advanced Social Work Field Internship I	5	
SW 654	Advanced Social Work Field Internship II	5	
SW 560	Advanced Policy Practice with Organizations and Communities	3	
SW 583	Advanced Social Work Practice with Family Systems	3	
SW 590	Social Work Capstone	2	
SW 551	Social Work Practice with Children and Adolescents	3	

Select at least six credit hours of the following:		6
SW 512	Social Work in Schools	
SW 515	Child Welfare	
SW 516	Addiction Recovery and Social Work Practice	
SW 517	Direct Practice with Older Adults	
SW 518	Child Welfare Seminar	
SW 525	Hunger and Homelessness	
SW 523	Social Work with Soldiers, Veterans, and Their Families	
SW 557	SW Program Development and Grant Writing	
SW 582	Advanced Social Work Practices with Groups	
SW 595	Special Topics in Social Work	
Total Hours		**63**

Advanced Standing Curriculum

Code	Title	Hours	Counts towards
Required Coursework			
SW 505	Human Behavior and the Social Environment: Social Justice	3	
SW 500	Advanced Standing Seminar	4	
SW 561	Social Work Administration and Supervision	3	
SW 581	Advanced Social Work Practice with Individuals	3	
SW 519	Evaluation of a Social Work Intervention	2	
SW 653	Advanced Social Work Field Internship I	5	
SW 583	Advanced Social Work Practice with Family Systems	3	
SW 560	Advanced Policy Practice with Organizations and Communities	3	
SW 590	Social Work Capstone	2	
SW 654	Advanced Social Work Field Internship II	5	
SW 551	Social Work Practice with Children and Adolescents	3	
Select at lest six credit hours of the following:		6	
SW 512	Social Work in Schools		
SW 515	Child Welfare		
SW 516	Addiction Recovery and Social Work Practice		
SW 517	Direct Practice with Older Adults		
SW 518	Child Welfare Seminar		
SW 525	Hunger and Homelessness		
SW 523	Social Work with Soldiers, Veterans, and Their Families		
SW 557	SW Program Development and Grant Writing		
SW 582	Advanced Social Work Practices with Groups		
SW 595	Special Topics in Social Work		
Total Hours		**42**	

Faculty

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Qiana Cryer-Coupet

Alan Reid Ellis

Sociology

For students who wish to become critical analysts of social problems, NC State's graduate program in sociology offers excellent training for academic, research and applied careers.

The 72-credit hour doctoral program is an intellectually stimulating and academically rigorous, yet supportive, environment.

Doctoral students have the opportunity to:

- Pursue a wide range of research topics and interests.
- Receive top-notch methodological training.
- Gain valuable teaching skills and experience.
- Collaborate on scholarly and applied research with our outstanding faculty and fellow graduate students.

Admitted Ph.D. students also benefit from a competitive award package that includes a 9-month stipend, health insurance, tuition remission, office space, and a travel funding allotment. Program alumni go on to succeed in academic and applied careers.

Degrees

- Sociology (MR) (p. 650)
- Sociology (MS) (p. 651)
- Sociology (PhD) (p. 652)
- Sociology, Humanities & Social Sciences (Minor) (p. 653)

Faculty

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Laura DeMarco

April Dawn Fernandes

Jessica Pfaffendorf

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Deann Judge

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L. Richard Dellafave

Ted Greenstein

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Patricia Lou McCall

Robert Lonnie Moxley

Maxine S. Thompson

Randy J. Thomson

Charles Ray Tittle

Eric M. Woodrum

Margaret A Zahn

James J. Zuiches

Lecturer

Karen Patricia Wirth

Sociology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**16**	
SOC 601	Seminar		
SOC 642	Practicum In Sociology		
SOC 701	Classical Sociological Theory		
SOC 711	Research Methods In Sociology I		
SOC 713	Applied Research		
Elective Courses		**15**	
Select a minimum of three 500- or 700-level courses approved in conjunction with the academic committee			
Additional elective courses will be determined in conjunction with the academic committee			
Total Hours		**31**	

Faculty

Full Professors

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Lecturer

Karen Patricia Wirth

Sociology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**16**	
SOC 601	Seminar		
SOC 642	Practicum In Sociology		
SOC 701	Classical Sociological Theory		
SOC 711	Research Methods In Sociology I		
SOC 713	Applied Research		
Elective Courses		**15**	
Select a minimum of three 500- or 700-level courses approved in conjunction with the academic committee			
Additional elective courses will be determined in conjunction with the academic committee			
Total Hours		**31**	

Faculty

Full Professors

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James J. Zuiches

Lecturer

Karen Patricia Wirth

Sociology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Requirements		**13**	
SOC 601	Seminar		
SOC 701	Classical Sociological Theory		
SOC 707	Quantitative Sociological Analysis		
SOC 711	Research Methods In Sociology I		
SOC 713	Applied Research		
Theory Course		**3**	
Select one of the following courses:			
SOC 705	Historical Materialism Approaches to Social Theory		
SOC 746	Sociological Social Psychology		
SOC 791	Special Topics In Sociology (Social Movement Theory)		
SOC 791	Special Topics In Sociology (Intersectional Theory)		
SOC 791	Special Topics In Sociology (Critical Race Theory)		
Method / Analysis Courses		**6**	
Select two of the following courses:			
SOC 708	Advanced Sociological Analysis (Social Network Analysis)		
SOC 708	Advanced Sociological Analysis (Multilevel/ Longitudinal Analysis)		
SOC 708	Advanced Sociological Analysis (Sequence Analysis)		
SOC 708	Advanced Sociological Analysis (Computational Text Analysis)		
SOC 715	Qualitative Sociological Methods and Analysis		
SOC 791	Special Topics In Sociology		
Substantive Courses		**24**	
Select eight courses from "Substantive Courses" listed below - based on speciality area			
Research Courses		**26**	
SOC 893	Doctoral Supervised Research		
SOC 895	Doctoral Dissertation Research		
Total Hours		**72**	

Specialty Courses

Select eight courses from the following options - based on speciality area.

Code	Title	Hours	Counts towards
Crime, Law, and Social Control			
SOC 721	Deviant Behavior	3	
SOC 722	Social Control	3	
SOC 725	Gender and Crime	3	
SOC 791	Special Topics In Sociology (Advanced Qualitative Sociological Methods and Analysis)	1-6	
Inequality: Class, Gender and Race			
SOC 736	Social Stratification	3	
SOC 737	Sociology Of Gender	3	
SOC 738	Race and Ethnic Inequality	3	
SOC 739	Social Psychology Of Inequality	3	
Work and The Global Economy Specialty Courses			
SOC 752	Work and Industry	3	
SOC 754	Economic Sociology	3	

SOC 755	Global Institutions and Markets	3
Food and Environment Specialty Courses		
SOC 761	Contemporary Debates in Food & Environment	3
SOC 762	Sociology of Food Systems	3
SOC 763	Environmental Sociology	3
SOC 791	Special Topics In Sociology (Food Systems)	1-6

Faculty

Full Professors

Sarah K. Bowen,

Martha L. Crowley

Stacy DeCoster

Steven J. McDonald

Toby L. Parcel

Michael L. Schwalbe

Thomas Eugene Shriver

Associate Professors

Michaela Anne DeSoucey

Kimberly Lynn Ebert

Stefano B. Longo

Anna Manzoni

William R. Smith

Melvin E. Thomas

Assistant Professors

Celeste Curington

Andrew Paul Davis

Laura DeMarco

April Dawn Fernandes

Jessica Pfaffendorf

Practice/Research/Teaching Professors

Megan Glancy

Deann Judge

Margaret Stiffler

Jim Yocom

Emeritus Faculty

Virginia M Aldige

Maxine Atikinson

Ronald F. Czaja

William B. Clifford II

L. Richard Dellafave

Ted Greenstein

Stephen C. Lilley

Patricia Lou McCall

Robert Lonnie Moxley

Maxine S. Thompson

Randy J. Thomson

Charles Ray Tittle

Eric M. Woodrum

Margaret A Zahn

James J. Zuiches

Lecturer

Karen Patricia Wirth

Sociology, Humanities & Social Sciences (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

Full Professors

Sarah K. Bowen,

Martha L. Crowley

Stacy DeCoster

Steven J. McDonald

Toby L. Parcel

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Kimberly Lynn Ebert

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Charles Ray Tittle

Eric M. Woodrum

Margaret A Zahn

James J. Zuiches

Lecturer

Karen Patricia Wirth

Technical Communication

The Master of Science in technical communication is designed to prepare professional communicators for advanced positions in industry and research organizations; with appropriate electives, students can prepare for careers in web design and development, software documentation, environmental communication, medical writing, industrial training in writing and editing, publications management and related areas.

Admission Requirements

Applicants should submit a personal statement, a resume, a writing sample, and three letters of recommendation. The application deadline is June 15. Those who wish to be considered for teaching assistantships should complete the application by February 1. Students are admitted for either the fall or spring semesters.

Requirements for MS in Technical Communication

The program requires 33 semester hours: 15 hours in the fields of technical writing, publication management, rhetoric and a projects course; the remaining hours are taken in applications, theory and methods and cross-disciplinary courses. Students must also satisfy a requirement for one semester of professional work experience.

Student Financial Support

Teaching assistantships are available for a limited number of promising students. These students work with an experienced teacher in their first year to assist in 300-level professional writing courses. They devote half time in subsequent semesters to teaching technical communication.

Degrees

- Technical Communication (MS) (p. 655)

Full Professors

Huiling Ding

Jason Swarts

Associate Professors

Stacey L. Pigg

Douglas M. Walls

Assistant Professors

Michelle McMullin

Emeritus Faculty

David H. Covington

Robert S. Dicks

Susan M. Katz

Carolyn Rae Miller

Nancy Penrose

Technical Communication (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
ENG 512	Theory and Research In Professional Writing		
ENG 515	Rhetoric Of Science and Technology		
ENG 517	Advanced Technical Writing, Editing and Document Design		
ENG 518	Publication Management for Technical Communicators		
ENG 675	Projects in Technical Communication		
Methods or Theory Electives		**9-12**	
Select a minimum of nine hours of coursework from "Methods or Theory Electives" listed below *			
Applications Electives		**6-9**	
Select a minimum of six hours of coursework from "Applications Electives" listed below *			
Total Hours		**33**	

* If a student chooses to take 9 credit hours of "Methods or Theory Electives", 9 credit hours of "Applications Electives" are required; if a student chooses to take 12 credit hours of "Methods or Theory Electives", only 6 credit hours of "Applications Electives" are required.

Methods or Theory Electives

Code	Title	Hours	Counts towards
Select a minimum of nine hours of coursework from the following:		**9-12**	
ENG 506	Verbal Data Analysis		
ENG 508	Usability Studies for Technical Communication		
ENG 519	Online Information Design and Evaluation		
ENG 520	Science Writing for the Media		
ENG 583	Studies In Rhetoric and Writing		
ECI 716	Design and Evaluation Of Instructional Materials		

Applications Electives

Code	Title	Hours	Counts towards
Select a minimum of six hours of coursework from the following:		**6-9**	
BUS 462	Marketing Research		
BUS 465	Traditional and Digital Brand Promotion		

COM 402	Advanced Group Communication
COM 411	Rhetorical Criticism
COM 421	Communication Law
COM 441	Ethical Issues in Communication
COM 442	Communication and Conflict Management
COM 456	Organizational Communication
COM 476	Public Relations Campaigns
COM 487	Internet and Society
COM 522	Critical Approaches to Organizational Communication
COM 523	International and Intercultural Communication
COM 527	Seminar in Organizational Conflict Management
COM 528	Communication Culture and Technology
COM 541	Quantitative Research Methods in Applied Communication
COM 542	Qualitative Research Methods in Applied Communication
COM 556	Seminar In Organizational Communication
COM 561	Human Communication Theory
COM 566	Seminar In Crisis Communication
CSC 442	Introduction to Data Science
CSC 454	Human-Computer Interaction
CSC 461	Computer Graphics
CSC 467	Multimedia Technology
CSC 501	Operating Systems Principles
CSC 510	Software Engineering
CSC 554	Human-Computer Interaction
EAC 540	Foundations of Higher Education and Student Affairs
EAC 559	The Adult Learner
EAC 580	Designing Instructional Systems in Training and Development
EAC 581	Advanced Instructional Design in Training and Development
EAC 582	Organization and Operation Of Training and Development Programs
EAC 583	Needs Assessment and Task Analysis in Training and Development
EAC 584	Evaluating Training Transfer and Effectiveness
EAC 585	Integrating Technology into Training Program
EAC 586	Methods and Techniques Of Training and Development
EAC 595	Special Topics
ECE 792	Special Topics In Electrical Engineering (Information Theory)
ECG 512	Law and Economics
ECG 515	Environmental and Resource Policy
ECG 537	Health Economics

ECG 715	Environmental and Resource Economics
ECI 716	Design and Evaluation Of Instructional Materials
ENG 508	Usability Studies for Technical Communication
ENG 513	Empirical Research In Composition
ENG 514	History Of Rhetoric
ENG 516	Rhetorical Criticism: Theory and Practice
ENG 519	Online Information Design and Evaluation
ENG 520	Science Writing for the Media
ENG 524	Introduction to Linguistics
ENG 525	Variety In Language
ENG 527	Discourse Analysis
ENG 541	Literary and Cultural Theory
ENG 583	Studies In Rhetoric and Writing (Gender and Medicine)
ENG 583	Studies In Rhetoric and Writing (Seminar on Communication in Health and Environmental Science)
ET 460	Practice of Environmental Technology
GC 420	Visual Thinking
GD 417/517	Information and Publishing Design Systems
HI 581	History of the Life Sciences
HI 582	Darwinism in Science and Society
NR 571	Current Issues in Natural Resource Policy
PA 511	Public Policy Analysis
PA 512	The Budgetary Process
PA 513	Public Organization Behavior
PA 514	Management Systems
PA 515	Research Methods and Analysis
PA 525	Organizational Development and Change Management
PA 540	Grant Writing for Public Administrators
PA 550	Environmental Policy
PS 502	The Legislative Process
PSY 410	Learning and Motivation
PSY 420	Cognitive Processes
PSY 425	Introduction to Cognitive Science
PSY 500	Visual Perception
PSY 508	Cognitive Processes
PSY 511	Advanced Social Psychology
PSY 525	Introduction To Cognitive Science
PSY 704	Learning and Motivation
PSY 740	Engineering Psychology of Human-computer Interaction
PSY 743	Human Factors Methods and Measurement
PSY 745	Human Performance Modeling
PSY 757	Innovation and Technology
PSY 764	Industrial Psychology

PSY 768	Organizational Psychology I
PSY 770	Organization Development and Change
SOC 410	Sociology of Organizations
SOC 450	Environmental Sociology
SOC 514	Developing Societies
SOC 610	Special Topics In Sociology
SOC 752	Work and Industry
SOC 753	Inequality in Work and the Economy
SOC 754	Economic Sociology
SOC 762	Sociology of Food Systems

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Full Professors

Huiling Ding

Jason Swarts

Associate Professors

Stacey L. Pigg

Douglas M. Walls

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Emeritus Faculty

David H. Covington

Robert S. Dicks

Susan M. Katz

Carolyn Rae Miller

Nancy Penrose

TEXT

Graduate Certificates - College of Humanities and Social Sciences

Certificates

- Digital Humanities (Certificate) (p. 604)
- Nonprofit Management (Certificate) (p. 640)
- Nuclear Nonproliferation Science and Policy (Certificate) (p. 660)
- Policy Analysis (Certificate) (p. 641)
- Professional Communication and Managerial Skills (Certificate) (p. 661)
- Public Policy (Certificate) (p. 662)

Digital Humanities (Certificate)

The Certificate in Digital Humanities is a designed for students from any discipline to construct a curriculum in digital humanities training and project work. The certificate is currently coordinated in the English department with participation across CHASS and other colleges.

The Graduate Certificate consists of a student-proposed curriculum of four 3-credit courses which must collectively satisfy the program's three requirements: contexts, training, and applications. In consultation with the coordinator, students can propose their own tracks through the certificate drawing from a broad array of approved courses at NC State as well as at UNC and Duke, as part of the Triangle Digital Humanities Network. Rather than insisting on a prescriptive definition and preset curriculum for "digital humanities," this certificate program encourages students to adapt course offerings in digital humanities or digital media to their own evolving research and professional interests in any variety of fields.

To qualify for admission to the Graduate Certificate in Digital Humanities, students must be enrolled in, or have completed, a Master's or PhD program at an accredited university. Applicants can be either non-degree or degree students. Degree students must have at the time of application a 3.00 grade point average in their graduate degree program. Non-degree students must have a final grade point average that is at least 3.00. Current degree students in English or CRDM may include no more than six (6) credits from the Certificate program in their degree program. Current degree students in History can apply up to nine (9) towards a doctorate. Students seeking the certificate from other programs must consult with those graduate coordinators to confirm allowed credits toward degree. The certificate will accept up to three hours of transfer credit from courses included in the curriculum. All GCP requirements must be completed within three (3) calendar years beginning on the date the student commences applicable courses.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select 12 credit hours of electives: [1]			
ENG 506	Verbal Data Analysis [1]		
ENG 519	Online Information Design and Evaluation		
ENG 583	Studies In Rhetoric and Writing		
ENG 584	Studies In Linguistics		
ENG 587	Interdisciplinary Studies in English		
CRD 702	Rhetoric and Digital Media		
HI 534	Theory and Practice of Digital History		
HI 535	Spatial History		
HI 599	Independent Study		
COM 537	Gaming and Social Networks		
COM 547	Mobile Media and Communication		
COM 598	Special Topics In Communication (Internet and Society)		
ADN 419	Creative Technology Studio I [2]		
ADN 423	Digital Modeling		
ADN 502	Graduate Art + Design Laboratory		
ADN 561	Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation [3]		
ECI 511	Introduction to Learning Design and Technology		
ECI 512	Emerging Technologies for Teaching and Learning		
ECI 513	Teaching and Learning with Digital Video		
ECI 514	Developing and Delivering Online Instruction		
ECI 515	Cultural Investigations and Technical Representations in Education		
ECI 516	Design and Evaluation Of Instructional Materials		
ECI 546	New Literacies & Media		
ECI 717	Advanced Multimedia Design and Applications in Instruction [4]		
Total Hours		**12**	

1 Additional courses available at UNC Chapel Hill

2 Prerequisites in the College of Design: ADN 419 Creative Technology Studio I requires D105 and ADN 219 Digital Imaging I

3 Prerequisites in the College of Design: ADN 561 Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation requires ADN 460 Creative Technology Studio II and ADN 419 Creative Technology Studio I.

4 Prerequisite: ECI 511 Introduction to Learning Design and Technology, ECI 514 Developing and Delivering Online Instruction

Nonprofit Management (Certificate)

A Graduate Certificate in Nonprofit Management is available to students, including NC State degree students, who have a Bachelor's degree from an accredited university. The Certificate requires 15 credit hours of course work and substantive nonprofit experience. The courses are designed to provide the basic management knowledge and skills needed in nonprofit organizations.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
PA 531	Human Resource Management in Public and Nonprofit Organizations		
PA 536	Management of Nonprofit Organizations		
PA 538	Nonprofit Budgeting and Financial Management		
PA 539	Fund Development		

Select up to two of the following:		6
PA 514	Management Systems	
PA 516	Effective Communications for Public Administrators	
PA 525	Organizational Development and Change Management	
PA 532	Contract Negotiation and Mediation in the Public and Nonprofit Sectors	
PA 540	Grant Writing for Public Administrators	
PA 546	Seminar in Program Evaluation	
COM 546	Nonprofit Marketing and Public Relations	
Total Hours		**18**

Substantive Experience Requirement

The Substantive Experience Requirement can be met by:

- Prior (or continuing) Experience:
  - Full-time employment with a nonprofit (at least one year by completion of certificate program)
  - Serving on a nonprofit board or chairing a nonprofit's standing committee (at least one year by completion of certificate program)
- In-program Work:
  - Internship or independent study with a nonprofit (at least 1 credit hour)
  - Completing a course with a field component (e.g., PA 546 or PA 525)

Faculty

Full Professors

Thomas A. Birkland

Richard M. Clerkin

Jerrell D. Coggburn

Dennis M. Daley

George D. Garson

Jennifer Kuzma

Branda L. Nowell

Associate Professors

Rajade M. Berry-James

James R. Brunet

Jason Alix Coupet

Jeffrey Childress Diebold

Christopher Galik

Bruce D. McDonald III

Amanda Janis Stewart

Emeritus Faculty

Michael L. Vasu

Nuclear Nonproliferation Science and Policy (Certificate)

The objective of the program is to educate students about nuclear nonproliferation, safeguards, and security from both the global and the technical perspectives. Students will be exposed to state-of-the-art techniques and will develop an understanding of the technical and policy challenges to maintain and support a robust nuclear nonproliferation regime. This process will be supported by assignments designed to reinforce understanding of the individual subject areas covered, class projects which cover key areas such as proliferation case studies and physical security simulations, as well as interactions with subject matter experts in nuclear nonproliferation technology and policy.

Plan Requirements

Code	Title	Hours	Counts towards
Nuclear Engineering Courses		**6**	
Select two courses from the following:			
NE 501	Reactor Analysis and Design		
NE 504	Radiation Safety and Shielding		
NE 505	Reactor Systems		
NE 512	Nuclear Fuel Cycles		
NE 520	Radiation and Reactor Fundamentals		
NE 541	Nuclear Nonproliferation Technology and Policy		
NE 723	Neutron Transport Theory		
NE 770	Nuclear Radiation Attenuation		

NE 795	Advanced Topics In Nuclear Engineering I	
Political Science/Public Administration Courses		**12**
PS 560	Nuclear Nonproliferation Policy & Process	
PS 561	Nuclear Strategy and Nonproliferation	
PS 532	Seminar in Global Governance	
PS 598	Special Topics In Political Science	
Total Hours		**18**

Policy Analysis (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
PA 507	The Public Policy Process		
PA 509	Applied Political Economy		
PA 511	Public Policy Analysis		
Select two electives [1]			
Total Hours		**15**	

[1] Policy courses from any program - approved by coordinator

Faculty

Full Professors

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Branda L. Nowell

Associate Professors

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Jeffrey Childress Diebold

Christopher Galik

Bruce D. McDonald III

Amanda Janis Stewart

Emeritus Faculty

Michael L. Vasu

Professional Communication and Managerial Skills (Certificate)

This online certificate program is designed to provide graduate students and professionals with a common platform of courses that will enhance their communication skills and professional development. In particular, professional science master's program students in the program will gain the management and communication training that will allow them to transfer success in the laboratory to success in the marketplace.

Admission Requirements

Students not attending NC State must apply through the regular application process. Proof of completion of a bachelor's degree is necessary. A minimum undergraduate GPA of 3.0 is required for admission to the certificate program. However, GRE scores are not required.

Students currently in a degree program at NC State may add the certificate program to their degree program by completing the application for currently enrolled graduate students.

Other Relevant Information

The interdisciplinary certificate requires a total of 12 credit hours, with 6 hours taken in the Poole College of Management and 6 hours taken in the College of Humanities and Social Sciences. Two required classes are BUS 590 (Management Foundations) and BUS 554 (Strategic Project Management). Two of the three following classes should also be taken: COM 521 (Communication and Globalization), COM 527 (Seminar in Organizational Conflict Management), or COM 530 (Interpersonal Communication in Science/Technology Organizations). To earn the certificate students must achieve a minimum 3.0 GPA in the program.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
BUS 501	Strategic Management Foundations		
BUS 554	Project Management		
Select two of the following:			
COM 521	Communication and Globalization		

COM 527	Seminar in Organizational Conflict Management	
COM 530	Interpersonal Communication in Science and Technology Organizations	
Total Hours		**12**

Public Policy (Certificate)

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**9**	
PA 507	The Public Policy Process		
PA 509	Applied Political Economy		
PA 511	Public Policy Analysis		
Elective Courses			
"Elective Courses" will be determined in conjunction with the academic committee		3	
Total Hours		**12**	

College of Natural Resources

Programs

- Environmental Assessment (p. 662)
- Forest Biomaterials (p. 664)
- Forestry and Environmental Resources (p. 669)
- Geospatial Analytics (p. 678)
- Geospatial Information Science & Technology (p. 680)
- Natural Resources (p. 684)
- Parks, Recreation, and Tourism Management (p. 689)

Degree Programs

Master's (MR)

- Environment Assessment (MR) (p. 663)
- Forest Biomaterials (MR) (p. 665)
- Forestry (MR) (p. 670)
- Geospatial Information Science and Technology (MR) (p. 681)
- Natural Resources (MR) (p. 686)

Master of Science (MS)

- Forest Biomaterials (MS) (p. 666)
- Forestry (MS) (p. 671)
- Natural Resources (MS) (p. 687)
- Parks, Recreation and Tourism Management (MS) (p. 691)

Doctor of Philosophy (PhD)

- Forest Biomaterials (PhD) (p. 667)
- Forestry and Environmental Resources (PhD) (p. 673)
- Geospatial Analytics (PhD) (p. 679)
- Parks, Recreation and Tourism Management (PhD) (p. 693)

Minors

- Forestry (Minor) (p. 676)
- Human Dimensions of Natural Resources (Minor) (p. 694)

Certificates

- Environmental Assessment (Certificate) (p. 696)
- Geographic Information Systems (Certificate) (p. 683)
- Renewable Energy Assessment and Development (Certificate) (p. 698)
- Sport and Entertainment Venue Management (Certificate) (p. 696)

Environmental Assessment

The Master of Environmental Assessment (EA) is an interdisciplinary program focused on understanding the adverse impacts that pollutants and naturally occurring substances pose on human health and the environment. Through the program, students combine multiple fields of study to tackle complex environmental problems. **The EA program can be completed entirely online.** This allows professionals the flexibility to complete their degree while still working.

Admission Requirements

Admissions to the Master of Environmental Assessment program requires an undergraduate GPA of 3.0 or better in a natural resources, environmental science and management, engineering, or related field, a professional resume, a personal statement describing the applicants professional ambitions and how the EA program will assist in accomplishing those goals. Students with less than a 3.0 undergraduate GPA may be considered for provisional admission to the EA program or referred to the EA certificate program to enhance their skills before reapplying. Graduate Record Exam (GRE) results are NOT required for admittance to the program.

Master's Degree Requirements

The EA program requires students to complete 30 credit hours of graduate coursework, including a 6 credit hour Project Course. Eighteen hours will be in required courses with the six hours selected from the list of elective courses or equivalent.

Students in the Master of Environmental Assessment program are generally self-supported, however students may also apply for financial aid.
Self-supported students may take up to 9 credit hours of course work per semester. However, students who are employed full time may find it advantageous to enroll in one or two courses per semester.

Other Relevant Information

The EA program also offers a Graduate Certificate in Environmental Assessment (12 credit hours). Certificate students may transfer up to 12

credits into the EA degree. Students enrolled in other NC State graduate programs may enroll in the Certificate program.

Degrees

- Environment Assessment (MR) (p. 663)

Full Professors

Stith Thompson Gower

Stacy Arnold Charles Nelson

Elizabeth Guthrie Nichols

Associate Professors

Gary B. Blank

Marcelo Luise Ardon Sayao

Jason Aaron Delborne

Assistant Professors

Jordan Kern

Louie Rivers

Practice/Research/Teaching Professors

Stephen E. Graham

Eric S. Money

Tamara J. Pandolfo

Jennifer Richmond-Bryant

Linda R. Taylor

Lecturers

Lyra Rakusin

Environment Assessment (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Requirements		**21**	
EA 501	Environmental Stressors		
EA 502	Environmental Risk Assessment		
EA 503	Environmental Exposure Assessment		
EA 504	Environmental Monitoring and Analysis		
GIS 510	Fundamentals of Geospatial Information Science and Technology		
EA 505	Environmental Assessment Law & Policy		
or PS 536	Global Environmental Law and Policy		
EA 665	Professional Project		
Elective Courses		**15**	
"Elective Courses" are approved in conjunction with the academic committee to meet 36 total hours			
Total Hours		**36**	

Full Professors

Stith Thompson Gower

Stacy Arnold Charles Nelson

Elizabeth Guthrie Nichols

Associate Professors

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Assistant Professors

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Tamara J. Pandolfo

Jennifer Richmond-Bryant

Linda R. Taylor

Lecturers

Lyra Rakusin

Forest Biomaterials

Course offerings and research facilities are available in the following areas: wood chemistry, biopolymer chemistry, bio-materials, bio-energy, pulping chemistry, process analysis, polymer chemistry, paper physics, paper recycling, wood physics (especially wood liquid relations), wood anatomy, wood biology, wood mechanics and engineering, wood machining, manufacturing processes, wood-based industry economics and marketing, and forest-based life cycle analysis.

Admission Requirements

Requirements listed here are in addition to graduate school requirements stated elsewhere. To be admitted, a student should have earned a B.S. degree with a major in wood and paper science or another suitable science or engineering degree. Students with a 3.0 GPA and with appropriate course backgrounds will be considered for admission. The GRE test scores are required except for the Master of Forest Biomaterials offered through Distance Education.

Master of Science Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. In addition, there are WPS core course requirements, which vary depending on the field of study. Six hours of research (FB 695) must be taken. Two hours of Seminar (FB 601) must be passed. A qualifying exam must be passed.

Master of Forest Biomaterials Degree Requirements

The Master of Forest Biomaterials is a non-thesis, professional degree for students not interested in a thesis-based research program. The Master of Forest Biomaterials degree is offered both on campus and through Distance Education. For the on-campus program a minimum of 36 course credits is required. The regulations regarding credits are the same as for the M.S. degree except that no credit for FB 695 is required or given and up to six credits of 400-level courses in the major field may be included. A technical report, which demonstrates the student's ability to gather, analyze and report information is required.

In addition to Graduate School requirements, the Distance Education program requires that the student be employed professionally in a wood or paper science or allied field, have one year of professional experience, and take required WPS core courses, which vary depending on the field of study. A minimum of 30 course credits is required of students who have relevant professional experience, including one hour of Seminar (FB 601) and five hours of an independent project (FB 625). For distance students without relevant professional experience, 36 hours is required.

Doctoral Degree Requirements

In addition to Graduate School requirements, Ph.D. candidates must present two departmental seminars (FB 801) before their final oral examination. Candidates must also write and defend a research proposal on their intended research (first proposition) and a research proposal on an area outside of their dissertation/thesis research (termed a second proposition) and pass qualifying exams.

Student Financial Support

A number of research assistantships and fellowships are available.

Other Relevant Information

Graduate students should select a committee chair and other advisory committee members and submit a plan of graduate work by the end of their first semester of residence. They are also required to take the qualifying examination as part of a Research Methods course. These examinations are to ensure that the student has the basic abilities to think independently as a scientist within the context of the forest biomaterials literature. The department believes M.S. and Ph.D. students should select a research topic and begin their dissertation or thesis research as early as possible.

As the field of forest biomaterials is a derived science, students are urged to develop a strong secondary area of excellence in one or more of the supporting disciplines such as organic chemistry, polymer chemistry, chemical engineering, mathematics, statistics, biology, engineering mechanics, mechanical engineering, physics, and economics or business administration.

Degrees

- Forest Biomaterials (MR) (p. 665)
- Forest Biomaterials (MS) (p. 666)
- Forest Biomaterials (PhD) (p. 667)

Faculty

Full Professors

Dimitris S. Argyropoulos

Marko Hakovirta

Martin A. Hubbe

Hasan Jameel

Stephen S. Kelley

Melissa Pasquinelli

David C. Tilotta

Richard A. Venditti

Associate Professors

Lucian A. Lucia

Philip H. Mitchell

Lokendra Pal

Sunkyu Park

Joel Justin Pawlak

Perry N. Peralta

Ilona Maria Peszlen

Leah C. Rathbun

Daniel Erique Saloni

Assistant Professors

Ronalds Wilfredo Gonzalez

Paul Frederik Laleicke

Nathalie Marie Lavoine

Yuan Yao

Practice/Research/Teaching Professors

Medwick V. Byrd

Elizabeth Kierepka

Rico Ruffino

Emeritus Faculty

Hou-Min Chang

Ellis B. Cowling

Earl L. Deal

Eric L. Ellwood

Edward T. Funkhouser

Irving S. Goldstein

John A. Heitmann Jr.

Larry G. Jahn

Magret Joyce

Adrianna G. Kirkman

Michael J. Kocurek

Ronald G. Pearson

Richard J. Thomas

Elisabeth A. Wheeler

Adjunct Faculty

Sujit Banerjee

Jesse Daystar

Richard Phillips

Forest Biomaterials (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**10**	
FB 601	Master's Seminar		
Select three of the following courses:			
FB 516	Forest Products Colloids & Surfaces		
FB 565	Forest Biomaterials Physics		
FB 723	Forest Biomaterials Chemistry		
FB 760	Engineering Unit Operations for Biomass Conversion		
Elective Courses		**17**	
FB 501	Masters Research Methods in Forest Biomaterials		
FB 510	Strategic Business Processes for the Forest Products Industry		
FB 522	Chemical Principles for the Papermaking Process Engineer		
FB 527	Wet-End and Colloidal Chemistry		
FB 576	Environmental Life Cycle Analysis		
FB 580	The Sustainable Bioeconomy		
Additional Courses		**9**	
"Additional Courses" will be approved in conjunction with the academic committee to meet 36 total hours			
Total Hours		**36**	

Faculty

Full Professors

Dimitris S. Argyropoulos

Marko Hakovirta

Martin A. Hubbe

Hasan Jameel

Stephen S. Kelley

Melissa Pasquinelli

David C. Tilotta

Richard A. Venditti

Associate Professors

Lucian A. Lucia

Philip H. Mitchell

Lokendra Pal

Sunkyu Park

Joel Justin Pawlak

Perry N. Peralta

Ilona Maria Peszlen

Leah C. Rathbun

Daniel Erique Saloni

Assistant Professors

Ronalds Wilfredo Gonzalez

Paul Frederik Laleicke

Nathalie Marie Lavoine

Yuan Yao

Practice/Research/Teaching Professors

Medwick V. Byrd

Elizabeth Kierepka

Rico Ruffino

Emeritus Faculty

Hou-Min Chang

Ellis B. Cowling

Earl L. Deal

Eric L. Ellwood

Edward T. Funkhouser

Irving S. Goldstein

John A. Heitmann Jr.

Larry G. Jahn

Magret Joyce

Adrianna G. Kirkman

Michael J. Kocurek

Ronald G. Pearson

Richard J. Thomas

Elisabeth A. Wheeler

Adjunct Faculty

Sujit Banerjee

Jesse Daystar

Richard Phillips

Forest Biomaterials (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
FB 501	Masters Research Methods in Forest Biomaterials		
FB 601	Master's Seminar		
Select three of the following courses:			
FB 516	Forest Products Colloids & Surfaces		
FB 565	Forest Biomaterials Physics		
FB 723	Forest Biomaterials Chemistry		
FB 760	Engineering Unit Operations for Biomass Conversion		
Elective Courses		**15**	
FB 510	Strategic Business Processes for the Forest Products Industry		

FB 522	Chemical Principles for the Papermaking Process Engineer	
FB 527	Wet-End and Colloidal Chemistry	
FB 576	Environmental Life Cycle Analysis	
FB 580	The Sustainable Bioeconomy	
Additional Course		**3**
"Additional Course" approved in conjunction with the academic committee to meet 30 total hours		
Total Hours		**30**

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Forest Biomaterials (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
FB 701	PhD Research Methods in Forest Biomaterials		

FB 801	Doctoral Seminar	
Select three of the following courses:		
FB 516	Forest Products Colloids & Surfaces	
FB 565	Forest Biomaterials Physics	
FB 723	Forest Biomaterials Chemistry	
FB 760	Engineering Unit Operations for Biomass Conversion	
Elective Courses		**15**
FB 510	Strategic Business Processes for the Forest Products Industry	
FB 522	Chemical Principles for the Papermaking Process Engineer	
FB 527	Wet-End and Colloidal Chemistry	
FB 576	Environmental Life Cycle Analysis	
FB 580	The Sustainable Bioeconomy	
Additional Courses		**55**
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours		
Total Hours		**82**

Faculty

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Forestry and Environmental Resources

The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

Admission Requirements

All parts of the application are considered in making decisions. Admission is competitive and depends on the willingness of at least one member of the faculty to serve as major professor. An undergraduate degree in forestry is not required. The GRE is no longer required for admission.

Master's Degree Requirements

The Master of Forestry is now accredited by the Society of American Foresters. It requires 40 credits, with a 1 credit project. The Master of Science course work requirements range from 30 to 36 credits. Students without an appropriate background will require additional preparatory work. For the M.S. degree, a minor is required.

Doctoral Degree Requirements

As a rule, students must complete a master's degree before entering the Ph.D. program. However, exceptionally well-prepared students may petition to have their degree objective changed to Ph.D. before completing the master's degree. In addition to the dissertation, Ph.D. programs require 36 to 54 credits of course work beyond the master's degree. A minor is required.

Student Financial Support

Stipend levels allow students to graduate without incurring significant debt. Those who begin without an assistantship are considered for funding as projects become available. Additional funding is available through a limited number of teaching assistantships.

Other Relevant Information

MS and PhD graduate students must meet the following requirements:

1. take a one-credit research methodology course, FOR 603 or FOR 803, early in his/her program;
2. take a seminar course (typically FOR 601/FOR 801), and
3. begin the final oral exam with a seminar to the department based on work accomplished during the graduate program.

Degrees

- Forestry (MR) (p. 670)
- Forestry (MS) (p. 671)
- Forestry and Environmental Resources (PhD) (p. 673)
- Forestry (Minor) (p. 676)

Robert Carroll Abt

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Roland Kays

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Kevin M Potter

Douglas J. Frederick

Dennis W. Hazel

Forestry (MR)

Degree Requirements

First Year		
Fall Semester		**Hours**
FOR 501	Dendrology *	3
FOR 502	Forest Measurements	1
SSC 461	Soil Physical Properties and Plant Growth *	3
FOR 574	Forest Mensuration and Modeling *	3
	Hours	**10**
Spring Semester		
FOR 504	The Practice of Silviculture	3
FOR 506	Silviculture Laboratory *	1
FOR 534	Forest Operations and Analysis *	3
GIS 510	Fundamentals of Geospatial Information Science and Technology	3
	Hours	**10**
Summer		
FOR 630	Independent Study in Forestry *	1
	Hours	**1**
Second Year		
Fall Semester		
NR 560	Renewable Natural Resource Management and Policy	3
PB 421	Plant Physiology	3
FOR 519	Forest Economics	3
	Hours	**9**
Spring Semester		
NR 500	Natural Resource Management	4
FOR 565	Plant Community Ecology *	4
FOR 531	Wildland Fire Science *	3
	Hours	**11**
	Total Hours	**41**

* Courses contain outdoor laboratories or assignments.

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Forestry (MS)

Degree Requirement

The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

Code	Title	Hours	Counts towards
Minor Courses		**9**	
Select a minor in another program			
Other Courses		**21**	
The additional courses that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee			
Total Hours		**30**	

Forestry Courses

Code	Title	Hours	Counts towards
Select courses from the following list to reach 30 - 36 total hours			
FOR 501	Dendrology	3	
FOR 502	Forest Measurements	1	
FOR 503	Tree Physiology	1	

FOR 504	The Practice of Silviculture	3
FOR 505	Forest Management	4
FOR 506	Silviculture Laboratory	1
FOR 508	Hardwood Management	3
FOR 509	Forest Resource Policy	1
FOR 513	Silviculture for Intensively Managed Plantations	3
FOR 514	Woodland Stewardship	3
FOR 519	Forest Economics	3
FOR 520	Watershed and Wetlands Hydrology	4
FOR 522	Consulting Forestry	3
FOR 531	Wildland Fire Science	3
FOR 532	Wildland Firefighter	3
FOR 534	Forest Operations and Analysis	3
FOR 540	Advanced Dendrology	3
FOR 561	Forest Communities of the Southeastern Coastal Plain	1
FOR 562	Forest Communities of the Southern Appalachians	1
FOR 565	Plant Community Ecology	4
FOR 574	Forest Mensuration and Modeling	3
FOR 575	Advanced Terrestrial Ecosystem Ecology	3
FOR 583	Tropical Forestry	3
FOR 595	Special Topics	1-6
FOR 601	Graduate Seminar	1
FOR 603	Research Methods in Forestry and Environmental Resources	1
FOR 610	Special Topics In Forestry	1-6
FOR 630	Independent Study in Forestry	1
FOR 685	Master's Supervised Teaching	1-3
FOR 688	Non-Thesis Masters Continuous Registration - Half Time Registration	1
FOR 689	Non-Thesis Master Continuous Registration - Full Time Registration	3
FOR 693	Master's Supervised Research	1-9
FOR 695	Master's Thesis Research	1-9
FOR 696	Summer Thesis Research	1
FOR 713	Advanced Topics In Silviculture	3
FOR 725	Forest Genetics	3
FOR 726	Advanced Topics In Quantitative Genetics and Breeding	3
FOR 727	Tree Improvement Research Techniques	3
FOR 728	Quantitative Forest Genetics Methods	3
FOR 734	Advanced Forest Management Planning	3
FOR 750	Ecological Restoration	3
FOR 753	Environmental Remote Sensing	3
FOR 784	The Practice Of Environmental Impact Assessment	4
FOR 795	Advanced Special Topics in Forestry	1-6

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Forestry and Environmental Resources (PhD)

Degree Requirements

The department offers training in all of the major sub-disciplines of forest, natural resources, and environmental-related science and management. Considerable flexibility is allowed in developing graduate programs tailored to the student's objectives.

Code	Title	Hours	Counts towards
Minor Courses		**12**	
Select a minor in another program			
Other Courses		**24-60**	

The additional courses that will be applied to reach 36-72 credit hours will be determined in conjunction with the academic committee	
Total Hours [1]	**36-72**

[1] 72 total hours beyond a Bachelor's degree. Students with a Master's degree from another university can count 18 credit hours from their Master's. Students with a Master's degree from NC State can count 18-36 credits from their masters, following the Graduate School rules and regulations.

Forestry Courses

Code	Title	Hours	Counts towards
FOR 501	Dendrology	3	
FOR 502	Forest Measurements	1	
FOR 503	Tree Physiology	1	
FOR 504	The Practice of Silviculture	3	
FOR 505	Forest Management	4	
FOR 506	Silviculture Laboratory	1	
FOR 508	Hardwood Management	3	
FOR 509	Forest Resource Policy	1	
FOR 513	Silviculture for Intensively Managed Plantations	3	
FOR 514	Woodland Stewardship	3	
FOR 519	Forest Economics	3	
FOR 520	Watershed and Wetlands Hydrology	4	
FOR 522	Consulting Forestry	3	
FOR 531	Wildland Fire Science	3	
FOR 532	Wildland Firefighter	3	
FOR 534	Forest Operations and Analysis	3	
FOR 540	Advanced Dendrology	3	
FOR 561	Forest Communities of the Southeastern Coastal Plain	1	
FOR 562	Forest Communities of the Southern Appalachians	1	
FOR 565	Plant Community Ecology	4	
FOR 574	Forest Mensuration and Modeling	3	
FOR 575	Advanced Terrestrial Ecosystem Ecology	3	
FOR 583	Tropical Forestry	3	
FOR 595	Special Topics	1-6	
FOR 601	Graduate Seminar	1	
FOR 603	Research Methods in Forestry and Environmental Resources	1	
FOR 610	Special Topics In Forestry	1-6	
FOR 630	Independent Study in Forestry	1	
FOR 685	Master's Supervised Teaching	1-3	
FOR 688	Non-Thesis Masters Continuous Registration - Half Time Registration	1	
FOR 689	Non-Thesis Master Continuous Registration - Full Time Registration	3	
FOR 693	Master's Supervised Research	1-9	
FOR 695	Master's Thesis Research	1-9	
FOR 696	Summer Thesis Research	1	
FOR 713	Advanced Topics In Silviculture	3	
FOR 725	Forest Genetics	3	
FOR 726	Advanced Topics In Quantitative Genetics and Breeding	3	
FOR 727	Tree Improvement Research Techniques	3	

FOR 728	Quantitative Forest Genetics Methods	3
FOR 734	Advanced Forest Management Planning	3
FOR 750	Ecological Restoration	3
FOR 753	Environmental Remote Sensing	3
FOR 784	The Practice Of Environmental Impact Assessment	4
FOR 795	Advanced Special Topics in Forestry	1-6
FOR 801	Seminar	1
FOR 803	Research Methods in Forestry and Environmental Resources	1
FOR 810	Special Topics In Forestry	1-6
FOR 885	Doctoral Supervised Teaching	1-3
FOR 893	Doctoral Supervised Research	1-9
FOR 895	Doctoral Dissertation Research	1-9
FOR 896	Summer Dissertation Research	1

Robert Carroll Abt

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Forestry (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Forestry Courses

Code	Title	Hours	Counts towards
FOR 501	Dendrology	3	
FOR 502	Forest Measurements	1	
FOR 503	Tree Physiology	1	
FOR 504	The Practice of Silviculture	3	
FOR 505	Forest Management	4	
FOR 506	Silviculture Laboratory	1	
FOR 508	Hardwood Management	3	
FOR 509	Forest Resource Policy	1	
FOR 513	Silviculture for Intensively Managed Plantations	3	
FOR 514	Woodland Stewardship	3	
FOR 519	Forest Economics	3	
FOR 520	Watershed and Wetlands Hydrology	4	
FOR 522	Consulting Forestry	3	
FOR 531	Wildland Fire Science	3	
FOR 532	Wildland Firefighter	3	
FOR 534	Forest Operations and Analysis	3	
FOR 540	Advanced Dendrology	3	
FOR 561	Forest Communities of the Southeastern Coastal Plain	1	
FOR 562	Forest Communities of the Southern Appalachians	1	
FOR 565	Plant Community Ecology	4	
FOR 574	Forest Mensuration and Modeling	3	
FOR 575	Advanced Terrestrial Ecosystem Ecology	3	
FOR 583	Tropical Forestry	3	
FOR 595	Special Topics	1-6	
FOR 601	Graduate Seminar	1	
FOR 603	Research Methods in Forestry and Environmental Resources	1	
FOR 610	Special Topics In Forestry	1-6	

FOR 630	Independent Study in Forestry	1
FOR 685	Master's Supervised Teaching	1-3
FOR 688	Non-Thesis Masters Continuous Registration - Half Time Registration	1
FOR 689	Non-Thesis Master Continuous Registration - Full Time Registration	3
FOR 693	Master's Supervised Research	1-9
FOR 695	Master's Thesis Research	1-9
FOR 696	Summer Thesis Research	1
FOR 713	Advanced Topics In Silviculture	3
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FOR 734	Advanced Forest Management Planning	3
FOR 750	Ecological Restoration	3
FOR 753	Environmental Remote Sensing	3
FOR 784	The Practice Of Environmental Impact Assessment	4
FOR 795	Advanced Special Topics in Forestry	1-6
FOR 801	Seminar	1
FOR 803	Research Methods in Forestry and Environmental Resources	1
FOR 810	Special Topics In Forestry	1-6
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FOR 895	Doctoral Dissertation Research	1-9
FOR 896	Summer Dissertation Research	1

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Geospatial Analytics

The Center for Geospatial Analytics innovative Ph.D. program brings together departments from across NC State University to train a new generation of interdisciplinary data scientists skilled in developing novel understanding of spatial phenomena and in applying new knowledge to grand challenges.

This one-of-a-kind degree focuses on integrative thinking and experiential learning:

- Multidisciplinary advising unites expertise from across complementary academic departments
- Cross-cutting curriculum spans core classes in solution-driven analytics and discipline-specific electives
- Geospatial externship enriches practical understanding through a one-week internship with an external partner

If your research goals intersect geospatial problem-solving from any number of fields, you will find your fit here. Our Faculty Fellows advise students interested in a range of disciplines—from design, to social and behavioral sciences, natural resources and the environment, computer science, engineering and more—and approach their work in a range of geospatial research areas. Students with strong backgrounds in quantitative methods in geography, data science, remote sensing and earth sciences are strongly encouraged to apply.

Degrees

- Geospatial Analytics (PhD) (p. 679)

Full Professors

Sankarasubramanian Arumugam

Emily Zechman Berglund

DelWayne R. Bohnenstiehl

David Brian Hill

Yu-Fai Leung

Ross Kendall Meentemeyer

Helena Mitasova

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Eric Shane Money

Jennifer Richmond-Bryant

Laura Gray Tateosian

Vaishnavi Thakar

Adjunct Faculty

Adam J. Terando

Research Associates

Georgina Sanchez Salas

Lindsey Smart

Chelsey Walden-Schreiner

Geospatial Analytics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**18**	
GIS 710	Geospatial Analytics for Grand Challenges		
GIS 711	Geospatial Data Management		
GIS 712	Environmental Earth Observation and Remote Sensing		
GIS 713	Geospatial Data Mining		
GIS 714	Geospatial Computation and Simulation		
GIS 715	Geovisualization		
Research / Elective Courses		**54**	
"Research / Elective Courses" are approved in conjunction with the academic committee to meet 72 total hours			
Total Hours		**72**	

Full Professors

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Jamian Krishna Pacifici

Jelena Vukomanovic

Practice/Research/Teaching Professors

Perver Korca Baran

Daniela Jones

Eric Shane Money

Jennifer Richmond-Bryant

Laura Gray Tateosian

Vaishnavi Thakar

Adjunct Faculty

Adam J. Terando

Research Associates

Georgina Sanchez Salas

Lindsey Smart

Chelsey Walden-Schreiner

Geospatial Information Science & Technology

The Master of Geospatial Information Science and Technology (MGIST) equips students with the necessary knowledge and tools to become high-end geospatial professionals using a unique curriculum that leverages NC State's strengths in computational and data sciences, information technology, and interdisciplinary training in combination with professional skills development in areas of project management, technical writing, and communications. The MGIST was designed to be completed entirely online, allowing flexibility for both students just entering the work force and working professionals.

Through a combination of geospatial theory, hands-on applications, and client-based service-learning experiences, students graduate from the program with a solid foundation to provide a wide range of geospatial expertise for local, state, national, and international organizations.

Admissions Requirements

Admission to the program requires an undergraduate GPA of 3.0 or better, a professional resume, a personal statement describing the applicant's professional ambitions and experience, and 3 letters of reference. Students with less than a 3.0 undergraduate GPA may be considered for provisional admission into the MGIST or referred to the GIS Certificate program to enhance skills and prepare for reapplication to the MGIST.

Master's Degree Requirements

The MGIST degree requires 33 course credit hours including a 3-credit-hour Capstone course and development of a professional portfolio highlighting geospatial analytic skills and competencies. A cumulative GPA of 3.0 or better is required in order to graduate. Specific course requirements are listed on the MGIST web site.

Student Financial Support

Students in this program are eligible for financial aid and may compete for program assistantships and internships.

Other Relevant Information

The GIS program also offers a Graduate Certificate in GIS (https://online-distance.ncsu.edu/program/graduate-certificate-in-geographic-information-science/) (12 credit hours). Certificate students may transfer up to 12 credits of B or better grades upon application and acceptance into the MGIST program.

Degrees

- Geospatial Information Science and Technology (MR) (p. 681)
- Geographic Information Systems (Certificate) (p. 683)

Faculty

Full Professors

Sankarasubramanian Arumugam

DelWayne R. Bohnenstiehl

David A. Crouse

George D. Garson

Christopher Graham Healey

Ronnie William Heiniger

George R. Hess

Hamid Krim

Thomas J Kwak

Duane K. Larick

Yu-Fai Leung

Jay Frederick Levine

Ross Kendall Meentemeyer

Helena Mitasova

Stacy A. C. Nelson

Margery Frances Overton

William John Rasdorf

Gary T. Roberson

Sandra E. Yuter

Associate Professors

William R. Smith

Ranga Raju Vatsavai

Karl William Wegmann

Jeffrey G. White

Stephen B. Wiley

Assistant Professors

Jelena Vukomanovic

Practice/Research/Teaching Professors

Perver Korca Baran

Eric Shane Money

Stacy Kathleen Supak

Laura Gray Tateosian

Vaishnavi Thakar

Geospatial Information Science and Technology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
GIS 501	Geospatial Professionalism		
GIS 510	Fundamentals of Geospatial Information Science and Technology		
GIS 530	Spatial Data Foundations		
GIS 540	Geospatial Programming Fundamentals		
GIS 550	Geospatial Data Structures and Web Services		
GIS 582	Geospatial Modeling		
GIS 590	Geospatial Information Science Master's Project		
GIS 660	MGIST Professional Portfolio		
Elective Courses		**12**	
Choose 12 credit hours of electives from the "Elective Courses" listed below, at least 6 of which must be GIS prefix courses			
Total Hours		**33**	

Elective Courses

Code	Title	Hours	Counts towards
Select at least six hours of GIS prefix courses below:		**6**	
GIS 512	Introduction to Environmental Remote Sensing		
GIS 515	Cartographic Design		
GIS 517	GIS Applications in Landscape Architecture and Environmental Planning		

GIS 520	Spatial Problem Solving
GIS 521	Surface Water Hydrology with GIS
GIS 532	Geospatial Data Science and Analysis
GIS 535	Web and Mobile GIS Protocols
GIS 595	Special Topics in Geospatial Information Science
GIS 584	Mapping and Analysis Using UAS
GIS 609	Geospatial Forum
GIS 610	Special Topics in Geospatial Information Science
GIS 630	Independent Study in Geospatial Information Science
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture
SSC 545	Remote Sensing Applications in Soil Science and Agriculture
BAE 535	Precision Agriculture Technology
BAE 536	GIS Applications in Precision Agriculture
MEA 511	Introduction to Meteorological Remote Sensing
HI 535	Spatial History
BUS 501	Strategic Management Foundations
BUS 554	Project Management
COM 521	Communication and Globalization
COM 530	Interpersonal Communication in Science and Technology Organizations
ST 501	Fundamentals of Statistical Inference I
ST 502	Fundamentals of Statistical Inference II
ST 511	Statistical Methods For Researchers I
ST 513	Statistics for Management and Social Sciences I
ST 514	Statistics For Management and Social Sciences II
ST 533	Applied Spatial Statistics
ST 555	Statistical Programming I
ST 556	Statistical Programming II
Total Hours	**6**

* Other courses not listed can be approved as an elective upon consultation with an advisor.

Faculty

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Vaishnavi Thakar

Geographic Information Systems (Certificate)

Building on NC State's strengths in technology, computational methods, and geographic information systems (GIS), this program provides professional, graduate-level academic preparation in the advanced application of GIS technologies to a wide spectrum of disciplines, including economics, public health, emergency planning and response, land use planning, environmental resources, etc. The certificate, which is also available to current NC State students enrolled in non-GIS graduate programs, forms the basis for the Master of Geospatial Information Science and Technology (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/).

Admissions Requirements

Admission to the certificate program requires a baccalaureate degree from an accredited college or university with at least a 3.0 GPA. Students with less than a 3.0 undergraduate GPA may still be considered for admission based on the remaining criteria or may be recommended to take one of our graduate courses as a non-degree student first. These determinations will be made on a case-by-case basis. All applicants must submit:

- Transcript showing Bachelor's degree conferred
- A clear and concise personal statement/statement of interest
- A resume/CV

Current NC State students in other degree programs may also be eligible to earn the certificate. These students should contact the Center for Geospatial Analytics for more information on how to apply.

Other relevant information

Up to 12 credit hours of B or better grades from the Certificate can transfer into the MGIST (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/) program if/when a student applies and is accepted into that program.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
GIS 510	Fundamentals of Geospatial Information Science and Technology		
GIS 520	Spatial Problem Solving		
Elective Courses		**6**	
Choose 6 credit hours of electives from the "Elective Courses" listed below, at least 3 of which must be GIS prefix courses			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
GIS 501	Geospatial Professionalism		
GIS 512	Introduction to Environmental Remote Sensing		
GIS 515	Cartographic Design		
GIS 517	GIS Applications in Landscape Architecture and Environmental Planning		
GIS 521	Surface Water Hydrology with GIS		
GIS 530	Spatial Data Foundations		
GIS 532	Geospatial Data Science and Analysis		
GIS 535	Web and Mobile GIS Protocols		

GIS 595	Special Topics in Geospatial Information Science
GIS/MEA 582	Geospatial Modeling
GIS 584	Mapping and Analysis Using UAS
GIS 609	Geospatial Forum
GIS 610	Special Topics in Geospatial Information Science
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture
SSC 545	Remote Sensing Applications in Soil Science and Agriculture
BAE 535	Precision Agriculture Technology
BAE 536	GIS Applications in Precision Agriculture
LAR 517	GIS Applications in Landscape Architecture and Environmental Planning
MEA 511	Introduction to Meteorological Remote Sensing
HI 535	Spatial History
ST 501	Fundamentals of Statistical Inference I
ST 502	Fundamentals of Statistical Inference II
ST 511	Statistical Methods For Researchers I
ST 513	Statistics for Management and Social Sciences I
ST 514	Statistics For Management and Social Sciences II
ST 533	Applied Spatial Statistics
ST 555	Statistical Programming I
ST 556	Statistical Programming II
Total Hours	**0**

* Other courses not listed can be approved as an elective upon consultation with an advisor.

Faculty

Full Professors

Ross Meentemeyer

Helena Mitasova

Stacy Nelson

Gary Roberson

Associate Professors

Jeffrey White

Practice/Research/Teaching Professors

Perver Baran

Eric Money

Stacy Supak

Laura Tateosian

Vaishnavi Thakar

Emeritus Faculty

Heather Cheshire

Hugh Devine

Siamak Khorram

Natural Resources

The natural resources program is an interdepartmental program designed to prepare students for positions in both private and public natural resource organizations. A selection of technical options couple core courses in natural resources issues and management with a series of related courses in a variety of related technical disciplines. The purpose of the natural resources core curriculum is to educate professionals at a Master's level who are well-versed in policy and regulation and who have skills in quantitative assessments. Currently approved technical options include: assessment and analysis, ecological restoration, economics and management, policy and administration, international resources, hydrology, and geographic information systems in the Department of Forestry and Environmental Resources; outdoor recreation management in the Department of Parks, Recreation and Tourism Management; and landscape architecture in the Department of Landscape Architecture.

Each option is available as either the M.S. in NR or as the non-thesis Master of NR.

Admissions Requirements

Students should have an undergraduate degree in natural resources or a related field. Experience in natural resources management and administration will be considered in lieu of an appropriate undergraduate degree. Admission is contingent upon meeting departmental requirements and acceptance by an advisor.

Master's Requirements

The M.S. degree requires a research thesis based on completion of a research project. The Master of NR degree requires a practical project which develops and demonstrates problem-solving skills. Students enrolled in the Department of Forestry and Environmental Resources must take FOR 603 in the first or second semester. The minimum number of credit hours varies by technical option, but is generally 36 credit hours including research or project credits and core courses.

Degrees

- Natural Resources (MR) (p. 686)
- Natural Resources (MS) (p. 687)

Faculty

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Carla E. Barbieri

Jason N. Bocarro

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Frederick Willis Cubbage

Myron Fran Floyd

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Douglas J. Frederick

John L. Havlin

George R. Hess

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Rajan Parajuli

Leah Rathbun

Louie Rivers

Kathryn Tate Stevenson

Jelena Vukomanovic

Jennifer Richmond Bryant

Stephanie Breard Jeffries

Laura Gray Tateosian

Natural Resources (MR)

Degree Requirements

Students may choose from the degree options below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Natural Resources" without option specifications.

Traditional Option

Code	Title	Hours	Counts towards
Required Courses		**10**	
NR 500	Natural Resource Management		
NR 571	Current Issues in Natural Resource Policy		
NR 601	Graduate Seminar [1]		
Select a graduate-level Statistics courses in conjunction with the academic committee			
Additional Courses		**26**	
"Additional Courses" are approved in conjunction with the academic committee to meet 36 total hours			
Total Hours		**36**	

[1] Equivalent seminar course may be accepted determined in conjunction with the academic committee.

Technical Options

Assessment and Analysis

This option allows students to develop a project incorporating field course components with decision making tools and the opportunity to develop depth in a specific subject matter focus. Focused on planning and conservation processes and efforts, the option aims to hone the abilities of people who will function as part of NEPA process teams, NGOs aiming to preserve and protect land and its biodiversity, or professionals performing Phase I, protected species investigations, and related assessment roles.

Ecological Restoration

This option prepares students to assist in the recovery of ecosystems that have been degraded, damaged, or destroyed. This requires extensive knowledge of the abiotic environments that sustain the biota of ecosystems, community structure, sustainable cultural practices, and performance monitoring, among other skills. Emphasis is on the actual craft of restoring natural ecosystems, and the social and philosophical elements that mandate restoration.

Economics and Management

Economics and Management option graduate students study the trade-offs associated with how society interacts with natural resources in order to assess and improve natural resource policy and management. Students focus on trade-offs at many different spatial and temporal scales. Examples include non-market valuation of ecosystem services, optimal management of forest stands with changing climate, carbon and market consequences of using biomass energy, sustainable development and long-term projections of ecological and economic sustainability.

GIS

This option provides students with a thorough background in the spatial sciences including spatial modeling, remote sensing, geographic information systems, and spatial databases. Students completing this option will be prepared for positions in a variety of federal agencies such as the USDA Forest Service, EPA, NOAA, or Corps of Engineers; with state agencies; with regional or local planning organizations; and with private consulting firms.

Hydrology

This option promotes understanding the hydrologic processes of watersheds and wetlands and prepares students for conducting hydrologic studies and directing watershed management programs. Courses also focus on water resources policy and regulation. Students are prepared for positions with private consulting firms as well as with many other public and private organizations that deal with the hydrologic impacts of land use and climate change.

International Resources

This option is designed to enhance students' understanding of international forestry and natural resource management and to prepare them for careers abroad or with internationally oriented institutions and companies in the US. Courses in this option are taught in several different departments and provide a broad background with rigorous technical emphases.

Landscape Architecture

This option is a non-thesis professional degree program. Students who complete all courses required for the technical option will receive a Master of Landscape Architecture and the Natural Resources Landscape Architecture with the Technical Option, curriculum code (NRD). No previous LAR degree is required. Students who are interested in becoming physical planners in municipalities, federal government, park and recreation planning as well as housing development and transportation planning will require a first professional degree in landscape architecture and are primary candidates for this second degree in the natural resources.

Outdoor Recreation

This technical option develops the knowledge and skills needed for planning and managing natural resource-based outdoor recreation opportunities and resources. Students are prepared for positions with federal, state, regional, county and municipal parks, recreation and land management agencies as well as with private firms and non-profit organizations.

Policy and Administration

This option develops knowledge and skills about policy processes and sciences, public and private organizations, natural resource law and policy, public governance and involvement, and their applications to natural resource management and conservation.

Faculty

Robert Carroll Abt

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Jelena Vukomanovic

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Laura Gray Tateosian

Natural Resources (MS)

Degree Requirements

Students may choose from the degree options below to complete coursework within a focus area.

Degrees earned will be distributed as: "Master of Science in Natural Resources" without option specifications.

Core Requirements

Code	Title	Hours	Counts towards
Required Courses		**10**	
NR 500	Natural Resource Management		
NR 571	Current Issues in Natural Resource Policy		
NR 601	Graduate Seminar [1]		
Select a graduate-level Statistics courses in conjunction with the academic committee			
Additional Courses		**20**	
"Additional Courses" are approved in conjunction with the academic committee to meet 30 total hours (may select a Technical Option listed below)			

NR 695	Master's Thesis Research	
Total Hours		**30**

[1] Equivalent seminar course may be accepted determined in conjunction with the academic committee.

Technical Options

Assessment and Analysis

This option allows students to develop a project incorporating field course components with decision making tools and the opportunity to develop depth in a specific subject matter focus. Focused on planning and conservation processes and efforts, the option aims to hone the abilities of people who will function as part of NEPA process teams, NGOs aiming to preserve and protect land and its biodiversity, or professionals performing Phase I, protected species investigations, and related assessment roles.

Ecological Restoration

This option prepares students to assist in the recovery of ecosystems that have been degraded, damaged, or destroyed. This requires extensive knowledge of the abiotic environments that sustain the biota of ecosystems, community structure, sustainable cultural practices, and performance monitoring, among other skills. Emphasis is on the actual craft of restoring natural ecosystems, and the social and philosophical elements that mandate restoration.

Economics and Management

Economics and Management option graduate students study the trade-offs associated with how society interacts with natural resources in order to assess and improve natural resource policy and management. Students focus on trade-offs at many different spatial and temporal scales. Examples include non-market valuation of ecosystem services, optimal management of forest stands with changing climate, carbon and market consequences of using biomass energy, sustainable development and long-term projections of ecological and economic sustainability.

GIS

This option provides students with a thorough background in the spatial sciences including spatial modeling, remote sensing, geographic information systems, and spatial databases. Students completing this option will be prepared for positions in a variety of federal agencies such as the USDA Forest Service, EPA, NOAA, or Corps of Engineers; with state agencies; with regional or local planning organizations; and with private consulting firms.

Hydrology

This option promotes understanding the hydrologic processes of watersheds and wetlands and prepares students for conducting hydrologic studies and directing watershed management programs. Courses also focus on water resources policy and regulation. Students are prepared for positions with private consulting firms as well as with many other public and private organizations that deal with the hydrologic impacts of land use and climate change.

International Resources

This option is designed to enhance students' understanding of international forestry and natural resource management and to prepare them for careers abroad or with internationally oriented institutions and companies in the US. Courses in this option are taught in several different departments and provide a broad background with rigorous technical emphases.

Landscape Architecture

This option is a non-thesis professional degree program. Students who complete all courses required for the technical option will receive a Master of Landscape Architecture and the Natural Resources Landscape Architecture with the Technical Option, curriculum code (NRD). No previous LAR degree is required. Students who are interested in becoming physical planners in municipalities, federal government, park and recreation planning as well as housing development and transportation planning will require a first professional degree in landscape architecture and are primary candidates for this second degree in the natural resources.

Outdoor Recreation

This technical option develops the knowledge and skills needed for planning and managing natural resource-based outdoor recreation opportunities and resources. Students are prepared for positions with federal, state, regional, county and municipal parks, recreation and land management agencies as well as with private firms and non-profit organizations.

Policy and Administration

This option develops knowledge and skills about policy processes and sciences, public and private organizations, natural resource law and policy, public governance and involvement, and their applications to natural resource management and conservation.

Faculty

Robert Carroll Abt

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Parks, Recreation, and Tourism Management

The Doctoral degree allows students to match their particular research interests and career aspirations with departmental research activities and faculty expertise. The primary areas of interest for students include health and well-being, human dimensions of the natural and built environment, sustainable and equitable tourism, and geospatial methods and modelling with a substantive area of study in another discipline.

The Master's degree provides students the opportunity to develop and enhance their critical understanding of both the conceptual foundations of parks, recreation and tourism management and the procedures of systematic inquiry and critical problem solving as applied to planning and management issues. The department offers educational opportunities and resources for the preparation of professionals concerned with planning, organizing, managing and directing parks, recreation, sport, and tourism programs, areas, and facilities. Two Master's Degree options are available, MS in Parks, Recreation and Tourism Management (thesis), and Online Professional Master of Parks, Recreation, Tourism and Sport Management (MPRTSM) (non-thesis). As part of the Natural Resources Masters Program (p. 684), the Department administers two degree options under the Outdoor Recreation Technical Option. In addition, the Graduate Certificate in Sport and and Entertainment Venue Management (p. 696) (SEVM) and the Human Dimensions of Natural Resources Graduate Minor (p. 694) are offered by the Department.

The general emphasis areas at the Master's level include: parks and recreation management, tourism development and management, geographic information systems, recreational sport management, and natural resource recreation management.

The online MPRTSM degree provides students with a solid professional and business education designed to advance their career development in parks, recreation, tourism, and sport industries. The online degree program operates on a cohort model and admits students in fall and spring semester.

Doctoral Degree Requirements

Although each doctoral course of study will be unique to the individual student, the usual course of study will include a minimum of 54 hours beyond the Master's. These credit hours are distributed among the core courses, statistics and research methods, a minor or substantive area consisting of 15 hours of course work approved by the student's faculty advisor, and the dissertation. Students are expected to have completed a Master's degree, preferably one with a thesis. Students without research experience will have to demonstrate an ability to produce scholarly work in PRTM.

Master's Degree Requirements

Each Master’s Degree has (Master of Parks, Recreation, and Tourism Management (p. 690) & Master of Science (p. 691)). The minimum credit hours range from 30 for MS in PRTM Degree, to 34 for MNR-Outdoor Recreation Technical Option Degree. Doctoral and M.S.

application deadline is February 15 for both U.S. and international students. Online Degree-MPRTSM application deadline is May 15.

Student Financial Support

Graduate assistantships are available to students in PhD and MS degree program on a competitive basis.

Degrees

- Parks, Recreation, Tourism and Sports Management (MR) (p. 690)
- Parks, Recreation and Tourism Management (MS) (p. 691)
- Parks, Recreation and Tourism Management (PhD) (p. 693)
- Human Dimensions of Natural Resources (Minor) (p. 694)
- Sport and Entertainment Venue Management (Certificate) (p. 696)

Faculty

Carla E. Barbieri

Jason N. Bocarro

Myron F. Floyd

Michael A. Kanters

Yu-Fai Leung

Erin Lynn Seekamp

Caren Beth Cooper

Gene Leroy Brothers

Kyle Stephen Bunds

Jonathan M. Casper

Bethany Brooke Cutts

Michael B. Edwards

James Aaron Hipp

Lincoln Ray Larson

Duarte B. Morais

Whitney Grace Knollenberg

Kangjae "Jerry" Lee

Kathryn Tate Stevenson

Jelena Vukomanovic

Perver Korca Baran

Kimberly Ann Bush

Keith Howard

Stacy Kathleen Supak

Laura Gray Tateosian

Aram Attarian

Hugh A. Devine Jr

Larry Douglas Gustke

Karla Ann Henderson

Roger Louis Moore

Chrys D. Siderelis

Candace Goode Vick

Parks, Recreation, Tourism, and Sports Management (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**22**	
PRT 500	Conceptual Foundations of Recreation		
PRT 503	Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations		
PRT 504	Data Management and Applications in Parks, Recreation, Tourism and Sport Management		
PRT 505	GIS and Spatial Analysis in PRTS		
PRT 506	Organizational Behavior and Leadership in Parks, Recreation, Tourism and Sport		
PRT 507	Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations		
PRT 508	Risk Management for Parks, Recreation, Tourism and Sport Organizations		

PRT 650	Professional Electronic Portfolio for Parks, Recreation and Tourism Management	
Elective Courses		**9**
"Elective Courses" are approved in conjunction with the academic committee to meet 31 total hours		
Total Hours		**31**

Faculty

Carla E. Barbieri

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Stacy Kathleen Supak

Laura Gray Tateosian

Aram Attarian

Hugh A. Devine Jr

Larry Douglas Gustke

Karla Ann Henderson

Roger Louis Moore

Chrys D. Siderelis

Candace Goode Vick

Parks, Recreation and Tourism Management (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
PRT 500	Conceptual Foundations of Recreation		
ST 511	Statistical Methods For Researchers I *		
PRT 701	Research Methods in Parks, Recreation, & Tourism Management		
PRT 695	Master's Thesis Research		
Elective Courses		**15**	
"Elective Courses" are approved in conjunction with the academic committee to meet 30 total hours (see "Suggested Electives" listed below)			
Total Hours		**30**	

* Students have the option to take ST 511 or above coursework in Experimental Statistics for Biological Sciences approved in conjunction with the academic committee.

Suggested Electives

Code	Title	Hours	Counts towards
Select a minimum of five elective courses:		**15**	
ANT 531	Tourism, Culture and Anthropology	3	
ANT 533	Anthropology of Ecotourism and Heritage Conservation	3	
COM 536/798	Seminar in Environmental Communication		
COM 562/798	Communication and Social Change	3	

DDN 779	Human Use of the Urban Landscape	3
ECG 540	Economic Development	3
ECI 709	Special Problems In Curriculum and Instruction (Elementary STEM and Environmental Learning in Informal Settings)	3
ED 711	Applied Quantitative Methods in Education II	3
ENG 626	Advanced Writing for Empirical Research	3
FOR 595	Special Topics (Environmental Justice and Decision Making)	1-6
GIS 510	Fundamentals of Geospatial Information Science and Technology	3
GIS 520	Spatial Problem Solving	3
HI/ANT 587	Cultural Resource Management	3
MEA 593	Special Topics in Atmospheric Science (Climate Communication)	1-6
NR 595	Special Topics in Natural Resources (Conserving Urban Biodiversity)	1-6
NR 400/500	Natural Resource Management	4
NR 460/560	Renewable Natural Resource Management and Policy	3
PA 515	Research Methods and Analysis	3
PA 536	Management of Nonprofit Organizations	3
PA 715	Quantitative Policy Analysis	3
PA 771	Seminar on Nonprofit Organizations	3
PRT 595/795	Special Topics In Recreation Resources (Social Science Research Methods in Natural Resources)	1-6
PRT 555	Environmental Impacts of Recreation and Tourism	3
PRT 795	Special Topics in Recreation Resources (Advanced qualitative research methods)	1-6
PSY 584	Advanced Developmental Psychology	3
SOC 711	Research Methods In Sociology I	3
SOC 791	Special Topics In Sociology (Seminar in Environmental Sociology)	1-6
ST 503	Fundamentals of Linear Models and Regression	3
ST 505	Applied Nonparametric Statistics	3
ST 507	Statistics For the Behavioral Sciences I	3
ST 508	Statistics For the Behavioral Sciences II	3
ST 511	Statistical Methods For Researchers I	3
ST 512	Statistical Methods For Researchers II	3
ST 590	Special Topics (Applied Bayesian Analysis)	1-6
ST 711	Design Of Experiments	3

ST 715	Theory Of Sampling Applied To Survey Design	3
ST 744	Categorical Data Analysis	3

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Candace Goode Vick

Parks, Recreation and Tourism Management (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses			
PRT 700	Advanced Theories in Park, Recreation and Tourism Research		
PRT 701	Research Methods in Parks, Recreation, & Tourism Management		
PRT 801	Doctoral Seminar in Parks, Recreation and Tourism Research		
Research Methods / Statistics Electives		**9**	
Select a Statistics Course in conjunction with the academic committee [1]			
Additional "Research Methods / Statistics Electives" are determined in conjunction with the academic committee			
Teaching Course		**3**	
PRT 885	Doctoral Supervised Teaching		
Substantive Area or Minor Courses		**15**	
"Substantive Area or Minor Courses" are determined in conjunction with the academic committee			
Dissertation Courses		**17**	
PRT 893	Doctoral Supervised Research		
PRT 895	Doctoral Dissertation Research		
Additional Courses		**28**	
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours			
Total Hours		**72**	

[1] Statistics course must be selected from ST 512 Statistical Methods For Researchers II or higher.

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Human Dimensions of Natural Resources (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
PRT 550	Human Behavior and the Environment		
FW 511	Human Dimensions of Wildlife and Fisheries		
Elective Courses		**3**	
Select a course listed under "Elective Courses" approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
PRT 550	Human Behavior and the Environment		
FW 511	Human Dimensions of Wildlife and Fisheries		
Elective Courses		**6**	
Select two courses listed under "Elective Courses" approved in conjunction with the academic committee			
Total Hours		**12**	

Elective Courses

PRTM Graduate Programs

Code	Title	Hours	Counts towards
PRT 555	Environmental Impacts of Recreation and Tourism		
PRT 560	Theory and Practice of Partnerships for Conservation and Community Sustainability		

PRT 700	Advanced Theories in Park, Recreation and Tourism Research		
PRT 701	Research Methods in Parks, Recreation, & Tourism Management		
PRT 705	Qualitative Research Methods in Conservation & Community Sustainability		

FWCB and FER Graduate Programs

Code	Title	Hours	Counts towards
FW 730	Ethics in Fisheries and Wildlife Sciences		

NR Graduate Programs

Code	Title	Hours	Counts towards
NR 500	Natural Resource Management		
NR 571	Current Issues in Natural Resource Policy		

College of Humanities and Social Sciences (CHASS) Graduate Programs

Code	Title	Hours	Counts towards
ANT 516	Research Methods in Cultural Anthropology		
ANT 550	Culture, Ecology, and Sustainable Living		
ANT 575	Environmental Archaeology		
HI 540	American Environmental History		
HI 587	Cultural Resource Management		
PA 515	Research Methods and Analysis		
PA 526	Social Equity in the Public Sector		
PA 527	Cultural Competence in the Public Sector		
PA 550	Environmental Policy		
PA 552	Science and Technology Policy		
SOC 763	Environmental Sociology		

pUBLIC sCIENCE gRADUATE pROGRAMS

Code	Title	Hours	Counts towards
EMS 594	Special Problems In Science Teaching (Learning in Informal Contexts)		
EMS 794	Special Problems in Science Teaching (Learning in Informal Contexts)		

College of Design Graduate Programs

Code	Title	Hours	Counts towards
LAR 542	Human Use of the Urban Landscape		

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Sport and Entertainment Venue Management (Certificate)

Whether you are interested in managing stadiums, amphitheaters, performing arts centers or sport arenas, this immersive facilities management program is right for you.

This one-year online graduate certificate program was designed in collaboration with industry experts to either advance your career or facilitate entry into this exciting field.

The 12-credit-hour graduate certificate program can be completed entirely online. Students are admitted as a cohort and complete all required courses as a group. Using an 8-week accelerated course format, students take one course at a time and finish the program in two semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
PRT 503	Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations	3	
PRT 507	Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations	3	
PRT 511	Sport and Entertainment Venue Management - Facilities	3	
PRT 512	Sport and Entertainment Venue Management - Operations and Services	3	
Total Hours		**12**	

Graduate Certificates - College of Natural Resources

Certificates

- Environmental Assessment (Certificate) (p. 696)
- Geographic Information Systems (Certificate) (p. 683)
- Renewable Energy Assessment and Development (Certificate) (p. 698)
- Sport and Entertainment Venue Management (Certificate) (p. 696)

Environmental Assessment (Certificate)

The graduate certificate program in Environmental Assessment provides students and professionals the opportunity to develop recognized academic credentials and advanced expertise in Environmental Assessment. The certificate program provides excellent opportunities for practicing environmental professionals to stay abreast of new technologies and current government regulations.

The curriculum consists of 12 credit hours selected from the required course listing for the MEA degree. Students may transfer up to 12 credit hours from the Certificate into the Masters of Environmental Assessment (MEA). Students may earn the Certificate as a stand-alone credential or as part of a graduate degree and may apply for entry into the MEA degree while in the Certificate program.

Admission Requirements

Admission to the certificate program requires proof of completion of a bachelor’s degree in an environmental, science, natural resources or related degree. Experience in the environmental field may be substituted for students with a bachelor's degree in an unrelated field. All applicants should have a minimum 3.0 grade point average. Interested individuals should be prepared to submit a personal statement, a resume identifying educational preparation and work experiences, and official transcripts of all undergraduate and graduate coursework.

With proper notification, students are not required to be enrolled continuously. The certificate must be completed within four (4) calendar years from the date the student starts the first course. Awarding of the certificate requires a minimum GPA of 3.0 or better in all of the required courses.

Certificate Requirements

Award of a certificate requires a GPA of 3.0 or better for the certificate courses (required and elective) and a grade of B- or better in all of the certificate courses.

Other Relevant Information

The Certificate is entirely online.

Plan Requirements

Code	Title	Hours	Counts towards
Core Course			
EA 505	Environmental Assessment Law & Policy	3	
or PA 536	Management of Nonprofit Organizations		
Select three of the following:		**9**	
EA 501	Environmental Stressors		
EA 502	Environmental Risk Assessment		
EA 503	Environmental Exposure Assessment		
EA 504	Environmental Monitoring and Analysis		
GIS 510	Fundamentals of Geospatial Information Science and Technology		
Total Hours		**12**	

Geographic Information Systems (Certificate)

Building on NC State's strengths in technology, computational methods, and geographic information systems (GIS), this program provides professional, graduate-level academic preparation in the advanced application of GIS technologies to a wide spectrum of disciplines, including economics, public health, emergency planning and response, land use planning, environmental resources, etc. The certificate, which is also available to current NC State students enrolled in non-GIS graduate programs, forms the basis for the Master of Geospatial Information Science and Technology (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/).

Admissions Requirements

Admission to the certificate program requires a baccalaureate degree from an accredited college or university with at least a 3.0 GPA. Students with less than a 3.0 undergraduate GPA may still be considered for admission based on the remaining criteria or may be recommended to take one of our graduate courses as a non-degree student first. These determinations will be made on a case-by-case basis. All applicants must submit:

- Transcript showing Bachelor's degree conferred
- A clear and concise personal statement/statement of interest
- A resume/CV

Current NC State students in other degree programs may also be eligible to earn the certificate. These students should contact the Center for Geospatial Analytics for more information on how to apply.

Other relevant information

Up to 12 credit hours of B or better grades from the Certificate can transfer into the MGIST (https://online-distance.ncsu.edu/program/master-of-geospatial-information-science-and-technology/) program if/when a student applies and is accepted into that program.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
GIS 510	Fundamentals of Geospatial Information Science and Technology		
GIS 520	Spatial Problem Solving		
Elective Courses		**6**	
Choose 6 credit hours of electives from the "Elective Courses" listed below, at least 3 of which must be GIS prefix courses			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
GIS 501	Geospatial Professionalism		
GIS 512	Introduction to Environmental Remote Sensing		
GIS 515	Cartographic Design		
GIS 517	GIS Applications in Landscape Architecture and Environmental Planning		
GIS 521	Surface Water Hydrology with GIS		
GIS 530	Spatial Data Foundations		
GIS 532	Geospatial Data Science and Analysis		
GIS 535	Web and Mobile GIS Protocols		

GIS 595	Special Topics in Geospatial Information Science
GIS/MEA 582	Geospatial Modeling
GIS 584	Mapping and Analysis Using UAS
GIS 609	Geospatial Forum
GIS 610	Special Topics in Geospatial Information Science
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture
SSC 545	Remote Sensing Applications in Soil Science and Agriculture
BAE 535	Precision Agriculture Technology
BAE 536	GIS Applications in Precision Agriculture
LAR 517	GIS Applications in Landscape Architecture and Environmental Planning
MEA 511	Introduction to Meteorological Remote Sensing
HI 535	Spatial History
ST 501	Fundamentals of Statistical Inference I
ST 502	Fundamentals of Statistical Inference II
ST 511	Statistical Methods For Researchers I
ST 513	Statistics for Management and Social Sciences I
ST 514	Statistics For Management and Social Sciences II
ST 533	Applied Spatial Statistics
ST 555	Statistical Programming I
ST 556	Statistical Programming II
Total Hours	**0**

* Other courses not listed can be approved as an elective upon consultation with an advisor.

Faculty

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Renewable Energy Assessment and Development (Certificate)

The Graduate Certificate in Renewable Energy Assessment and Development at NC State University provides students with graduate level academic credentials in renewable energy assessment and development. The program is designed for students who wish to enhance their knowledge of renewable energy assessment practices and obtain a background for certification. The Certificate can be completed entirely online. The certificate is available to current NC State students enrolled in graduate degrees. The entire program requires 12 credits hours. Students in the Renewable Energy Assessment and Development Certificate program may wish to continue on to a Graduate degree. Students may transfer up to 6 credit hours from the Renewable Energy Assessment and Development Certificate into the Master of

Environmental Assessment upon application and acceptance into the program.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses			
EA 520	Renewable Energy Policy and Economics	3	
EA 521	Fundamentals of Renewable Energy Site Assessment	3	
or ECE 552	Renewable Electric Energy Systems		
EA 522	Photovoltaic Design and Assessment	3	
EA 523	Assessment of Renewable Energy Storage Systems	3	
or ECE 552	Renewable Electric Energy Systems		
Total Hours		**12**	

Sport and Entertainment Venue Management (Certificate)

Whether you are interested in managing stadiums, amphitheaters, performing arts centers or sport arenas, this immersive facilities management program is right for you.

This one-year online graduate certificate program was designed in collaboration with industry experts to either advance your career or facilitate entry into this exciting field.

The 12-credit-hour graduate certificate program can be completed entirely online. Students are admitted as a cohort and complete all required courses as a group. Using an 8-week accelerated course format, students take one course at a time and finish the program in two semesters.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
PRT 503	Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations	3	
PRT 507	Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations	3	
PRT 511	Sport and Entertainment Venue Management - Facilities	3	
PRT 512	Sport and Entertainment Venue Management - Operations and Services	3	
Total Hours		**12**	

College of Sciences

Programs

- Applied Mathematics (p. 700)
- Biology (p. 115)
- Biomathematics (p. 715)
- Chemistry (p. 721)
- Climate Change and Society (p. 728)
- Marine, Earth and Atmospheric Sciences (p. 729)
- Mathematics (p. 739)
- Microbiology (p. 167)
- Physics (p. 752)
- Statistics (p. 758)
- Toxicology (p. 773)

Degree Programs

Master's (MR)

- Biology (MR) (p. 117)
- Microbiology (MR) (p. 169)

Master of Science (MS)

- Applied Mathematics (MS) (p. 702)
- Biology (MS) (p. 119)
- Biomathematics (MS) (p. 717)
- Chemistry (MS) (p. 723)
- Marine, Earth, and Atmospheric Sciences (MS) (p. 731)
- Mathematics (MS) (p. 741)
- Microbiology (MS) (p. 170)
- Physics (MS) (p. 754)
- Statistics (MS) (p. 768)
- Toxicology (MS) (p. 775)

Doctor of Philosophy (PhD)

- Applied Mathematics (PhD) (p. 705)
- Applied Mathematics (PhD): Computational Mathematics Concentration (p. 708)
- Biology (PhD) (p. 124)
- Biomathematics (PhD) (p. 718)
- Chemistry (PhD) (p. 725)
- Marine, Earth, and Atmospheric Sciences (PhD) (p. 733)
- Mathematics (PhD) (p. 744)
- Mathematics (PhD): Interdisciplinary Mathematics Concentration (p. 746)
- Microbiology (PhD) (p. 173)
- Physics (PhD) (p. 755)
- Statistics (PhD) (p. 769)
- Toxicology (PhD) (p. 776)

Minors

- Applied Mathematics (Minor) (p. 713)
- Biomathematics (Minor) (p. 720)
- Chemistry (Minor) (p. 726)
- Marine, Earth, & Atmospheric Sciences (Minor) (p. 735)
- Mathematics (Minor) (p. 748)
- Microbiology (Minor) (p. 175)
- Physics (Minor) (p. 757)
- Statistics (Minor) (p. 771)
- Toxicology (Minor) (p. 778)
- Zoology (Minor) (http://catalog.ncsu.edu/undergraduate/sciences/biological-sciences/zoology-minor/)

Certificates

- Applied Statistics and Data Management (Certificate) (p. 772)
- Biology for Educators (Certificate) (p. 779)
- Climate Adaptation (Certificate) (p. 739)
- Mathematics (Certificate) (p. 752)
- Statistics Education (Certificate) (p. 772)

Applied Mathematics

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy in Mathematics and in Applied Mathematics. Students may opt for the Concentration in Computational Mathematics, which is attached to the program in applied mathematics. The Concentration in Interdisciplinary Mathematics (MAI) is available to Ph.D. students in either Mathematics or Applied Mathematics. It is not available to Masters Students. Joint research endeavors with industrial and governmental partners are facilitated and encouraged. The Department of Mathematics also offers a Certificate.

Admissions Requirements

Applicants for admission should have an undergraduate or Master's degree in mathematics or applied mathematics. This should include courses in advanced calculus, analysis, modern algebra and linear algebra. Applicants with degrees in other subjects may be admitted but may be required to take certain undergraduate courses in mathematics without receiving graduate credit. GRE general scores are required. The GRE Subject Test in Mathematics is not required but a good score can be a positive factor in admission.

Master of Science Requirements

The M.S. degree requires a minimum of 30 credit hours with courses chosen to satisfy certain requirements to cover material from three different areas in the department, and some level of depth of material.

Ph.D. Requirements

The Ph.D. requires a minimum of 72 credit hours. A student will typically take 50-60 semester hours of course credits for the Ph.D. The written preliminary examination consists of examinations in three areas of mathematics chosen by the student from 12 possibilities. The research dissertation should represent a substantial contribution to an area of mathematics or its applications.

Student Financial Support

Teaching assistantships and some research assistantships are available. Teaching assistants benefit from a structured program of training in university-level teaching.

Degrees

- Applied Mathematics (MS) (p. 702)
- Applied Mathematics (PhD) (p. 705)
- Applied Mathematics (PhD): Computational Mathematics Concentration (p. 708)
- Applied Mathematics (PhD): Interdisciplinary Applied Math Concentration (p. 711)
- Applied Mathematics (Minor) (p. 713)

Faculty

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R. White

Applied Mathematics (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses [1]		**30**	
See "Required Courses" listed below			
MA 676	Master's Project (Optional)		
In Depth Courses			
See "In Depth Course Sequences" listed below			
Total Hours		**30**	

1 At least 18 credits must be MA courses level (500+)

2 Up to 9 credits may be in math related disciplines, determined in conjunction with the academic committee

Required Courses

Code	Title	Hours	Counts towards
Select at least one course from each category below:			
Continuous Mathematics			
MA 513	Introduction To Complex Variables	3	
MA 515	Analysis I	3	
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 532	Ordinary Differential Equations I	3	
MA 534	Introduction To Partial Differential Equations	3	
MA 546	Probability and Stochastic Processes I	3	
MA 551	Introduction to Topology	3	
MA 555	Introduction to Manifold Theory	3	
Discrete Mathematics			
MA 505	Linear Programming	3	
MA 520	Linear Algebra	3	
MA 521	Abstract Algebra I	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 524	Combinatorics I	3	

MA 526	Mathematical Analysis II	3
Computational Mathematics		
MA 522	Computer Algebra	3
MA 540	Uncertainty Quantification for Physical and Biological Models	3
MA/CS 565	Graph Theory	3
MA 573	Mathematical Modeling of Physical and Biological Processes I	3
MA 580		3

In Depth Course Sequences

Code	Title	Hours	Counts towards
Select two course sequences or three related courses from the categories below:			
Analysis Course Sequence			
MA 515	Analysis I	3	
MA 715	Measure Theory and Integration	3	
Linear & Lie Algebra Course Sequence			
MA 520	Linear Algebra	3	
MA 720	Lie Algebras	3	
Abstract Algebra Course Sequence			
MA 521	Abstract Algebra I	3	
MA 721	Abstract Algebra II	3	
Computer Algebra Course Sequence			
MA 522	Computer Algebra	3	
MA 722	Computer Algebra II	3	
Matrix Theory Course Sequence			
MA 523	Linear Transformations and Matrix Theory	3	
MA 723	Theory of Matrices and Applications	3	
Combinatorics Course Sequence			
MA 524	Combinatorics I	3	
MA 724	Combinatorics II	3	
Control Course Sequence			
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 731	Dynamic Systems and Multivariable Control II	3	
PDEs Course Sequence			
MA 534	Introduction To Partial Differential Equations	3	
MA 734	Partial Differential Equations	3	
Probability Course Sequence			
MA 546	Probability and Stochastic Processes I	3	
MA 747	Probability and Stochastic Processes II	3	
Topology Course Sequence			
MA 551	Introduction to Topology	3	
MA 753	Algebraic Topology	3	
Differential Geometry Course Sequence			
MA 555	Introduction to Manifold Theory	3	
MA 755	Introduction to Riemannian Geometry	3	
Modeling Course Sequence			
MA 573	Mathematical Modeling of Physical and Biological Processes I	3	
MA 574	Mathematical Modeling of Physical and Biological Processes II	3	
Numerical Analysis Course Sequence			
MA 580		3	
MA 780	Numerical Analysis I	3	
Other			
Three related courses approved in conjunction with the academic committee		9	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Applied Mathematics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**72**	
See "Required Courses" listed below *			
Total Hours		**72**	

* Must contain a minimum of 30 credit hours of 500-level or above MA courses

Required Courses

Code	Title	Hours	Counts towards
Select at least one course from each category below:			
Continuous Mathematics			

MA 513	Introduction To Complex Variables	3
MA 515	Analysis I	3
MA 531	Dynamic Systems and Multivariable Control I	3
MA 532	Ordinary Differential Equations I	3
MA 534	Introduction To Partial Differential Equations	3
MA 546	Probability and Stochastic Processes I	3
MA 551	Introduction to Topology	3
MA 555	Introduction to Manifold Theory	3
Discrete Mathematics		
MA 505	Linear Programming	3
MA 520	Linear Algebra	3
MA 521	Abstract Algebra I	3
MA 523	Linear Transformations and Matrix Theory	3
MA 524	Combinatorics I	3
MA 526	Mathematical Analysis II	3
Computational Mathematics		
MA 522	Computer Algebra	3
MA 540	Uncertainty Quantification for Physical and Biological Models	3
MA/CS 565	Graph Theory	3
MA 573	Mathematical Modeling of Physical and Biological Processes I	3
MA 580		3

Faculty

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Applied Mathematics (PhD): Computational Mathematics Concentration

Code	Title	Hours	Counts towards
Required Courses *		**63**	
See "Required Courses" listed below			
Computational Mathematics Concentration Requirements		**9**	
See "Computational Mathematics Concentration Courses" listed below			
Total Hours		**72**	

* Must contain a minimum of 30 credit hours of 500-level or above MA courses.

Required Courses

Code	Title	Hours	Counts towards
Select at least one course from each category below:			
Continuous Mathematics			
MA 513	Introduction To Complex Variables	3	
MA 515	Analysis I	3	
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 532	Ordinary Differential Equations I	3	
MA 534	Introduction To Partial Differential Equations	3	
MA 546	Probability and Stochastic Processes I	3	
MA 551	Introduction to Topology	3	
MA 555	Introduction to Manifold Theory	3	
Discrete Mathematics			
MA 505	Linear Programming	3	
MA 520	Linear Algebra	3	
MA 521	Abstract Algebra I	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 524	Combinatorics I	3	
MA 526	Mathematical Analysis II	3	
Computational Mathematics			
MA 522	Computer Algebra	3	
MA 540	Uncertainty Quantification for Physical and Biological Models	3	
MA/CS 565	Graph Theory	3	
MA 573	Mathematical Modeling of Physical and Biological Processes I	3	
MA 580		3	

Computational Mathematics Concentration Courses

Code	Title	Hours	Counts towards
Select at least three courses from the following:			
MA 522	Computer Algebra	3	
MA 540	Uncertainty Quantification for Physical and Biological Models	3	
MA 544	Computer Experiments In Mathematical Probability	3	
MA 565	Graph Theory	3	
MA 573	Mathematical Modeling of Physical and Biological Processes I	3	
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3	

MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA 784	Nonlinear Equations and Unconstrained Optimization	3
MA 788	Numerical Nonlinear Partial Differential Equations	3
CSC 501	Operating Systems Principles	3
CSC 505	Design and Analysis Of Algorithms	3
CSC 506	Architecture Of Parallel Computers	3
CE 537	Computer Methods and Applications	3
CSC 512	Compiler Construction	3
PY 525	Computational Physics	3
ECE 513	Digital Signal Processing	3
MAE 560	Computational Fluid Mechanics and Heat Transfer	3
ST 555	Statistical Programming I	3
FIM 548	Monte Carlo Methods for Financial Math	3

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Applied Mathematics (PhD): Interdisciplinary Applied Math Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**66**	
See "Required Courses" listed below			
Additional Courses		**6**	
Select a minimum of two "Additional Courses" from other disciplines approved in conjunction with the academic committee			
Total Hours		**72**	

Required Courses

Code	Title	Hours	Counts towards
Select at least one course from each category below:			
Continuous Mathematics			
MA 513	Introduction To Complex Variables	3	
MA 515	Analysis I	3	
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 532	Ordinary Differential Equations I	3	
MA 534	Introduction To Partial Differential Equations	3	
MA 546	Probability and Stochastic Processes I	3	
MA 551	Introduction to Topology	3	
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Discrete Mathematics			
MA 505	Linear Programming	3	
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MA 521	Abstract Algebra I	3	
MA 523	Linear Transformations and Matrix Theory	3	
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Computational Mathematics			
MA 522	Computer Algebra	3	
MA 540	Uncertainty Quantification for Physical and Biological Models	3	
MA/CS 565	Graph Theory	3	
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MA 580		3	

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Applied Mathematics (Minor)

Plan Requirements

Master's Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
A minimum of nine hours of coursework in mathematics [1, 2]			
Total Hours		**9**	

PhD Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select a minimum of twelve credit hours coursework in mathematics [1, 2]			
Total Hours		**12**	

1 Students must maintain a 3.0 GPA in all minor courses.

2 At least six credits must be taken at the 500- or 700-level.

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Biomathematics

Biomathematics is an interdisciplinary graduate program offering courses and research opportunities in basic and applied mathematical biology. Degree programs are flexible to accommodate students with backgrounds in the biological, mathematical or physical sciences. The program also offers Ph.D. and master's-level minors.

Admission Requirements

Applicants should have either a Bachelor's degree in biology with evidence of aptitude and interest in mathematics, or a bachelor's in a mathematical science with evidence of aptitude and interest in biology. Advanced (multivariate) calculus, linear algebra and general biology are prerequisites for all BMA courses, and deficiencies in these should be remedied during the first year of graduate study. The application must include a narrative statement (1-2 pages) of the applicant's goals and reasons for interest in the BMA program.

Master's Degree Requirements

The M.S. and M.BMA. degrees require BMA 771-BMA 772 and one other BMA course; two upper-level biology courses; and three courses from the mathematical sciences or statistical sciences. The M.S. degree requires a thesis, and the M.BMA. requires two additional courses and a written project.

Doctoral Degree Requirements

Course requirements consist of a "core" and a "concentration" in some area of biology or mathematical sciences. Core requirements are: BMA 771-BMA 772, BMA 773 and BMA 774; three upper-level biology courses from at least two areas (e.g., physiology and evolution); and additional courses from the mathematical or statistical sciences. Concentration consists of either a Ph.D. co-major in a biological or mathematical science or a coherent series of five graduate courses approved by the student's committee, which must include a two-semester sequence and at least one 700-level course.

Financial Assistance

TAs (generally in the Departments of Mathematics or Statistics). RAs and internships are available. Awards are based on GRE scores, transcripts, letters of recommendation, and the personal statement. RAs usually are held by continuing students. To receive full consideration for financial aid, the completed application must be received by January 15.

Other Relevant Information

All students are required to participate in the BMA Graduate Seminar. Course requirements can be met by examination or by demonstrating that an equivalent course was completed at another university.

Degrees

- Biomathematics (MR) (p. 716)
- Biomathematics (MS) (p. 717)
- Biomathematics (PhD) (p. 718)
- Biomathematics (Minor) (p. 720)

Faculty

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Biomathematics (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
BMA 567	Modeling of Biological Systems		
or BMA 773	Stochastic Modeling		
or BMA 774	Partial Differential Equation Modeling in Biology		
BMA 771	Biomathematics I		
BMA 772	Biomathematics II		
BMA 801	Seminar [1]		
Biological Science Courses		**6**	
"Biological Science Courses" will be approved in conjunction with the academic committee			
Statistics Courses		**3-6**	
Required "Statistics Courses" will be approved in conjunction with the academic committee – see "Statistics Course Options" listed below			
Mathematical Science Courses		**6**	
"Mathematical Science Courses" will be approved in conjunction with the academic committee			
Elective Courses		**6**	
"Elective Courses" are approved in conjunction with the academic committee to meet 36 total hours			
Total Hours		**36**	

[1] BMA 801 Seminar must be repeated to meet the two credit hour requirement.

Statistics Course Options

Option 1

Code	Title	Hours	Counts towards
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	
Total Hours		**6**	

Option 2

Code	Title	Hours	Counts towards
ST 512	Statistical Methods For Researchers II (R)	3	
Total Hours		**3**	

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Biomathematics (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
BMA 567	Modeling of Biological Systems		
or BMA 773	Stochastic Modeling		
or BMA 774	Partial Differential Equation Modeling in Biology		
BMA 771	Biomathematics I		
BMA 772	Biomathematics II		
BMA 801	Seminar [1]		
Biological Science Courses		**6**	
"Biological Science Courses" will be approved in conjunction with the academic committee			
Statistics Courses		**3-6**	
Required "Statistics Courses" will be approved in conjunction with the academic committee – see "Statistic Course Options" listed below			
Mathematical Science Courses		**6**	
"Mathematical Science Courses" will be approved in conjunction with the academic committee			
Written Thesis			
Students must complete a written thesis to receive a Master of Science Degree			
Total Hours		**30**	

[1] BMA 801 Seminar must be repeated to meet the two credit hour requirements.

Statistics Course Options

Option 1

Code	Title	Hours	Counts towards
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	
Total Hours		**6**	

Option 2

Code	Title	Hours	Counts towards
ST 512	Statistical Methods For Researchers II (R)	3	
Total Hours		**3**	

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Biomathematics (PhD)

Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area.

Degrees earned will be distributed as: "Doctor of Philosophy in Biomathematics" without track specifications.

Code	Title	Hours	Counts towards
Required Courses		**15**	
BMA 771	Biomathematics I		
BMA 772	Biomathematics II		
BMA 773	Stochastic Modeling		
BMA 774	Partial Differential Equation Modeling in Biology		
BMA 801	Seminar [1]		
Biological Sciences Courses		**9**	
"Biological Science Courses" will be approved in conjunction with the academic committee [2]			
Statistics Courses		**3-6**	
Required "Statistics Courses" will be approved in conjunction with the academic committee – see "Statistic Course Options" listed below			
Mathematical Science Courses		**9**	
"Mathematical Science Courses" will be approved in conjunction with the academic committee			
Focus Area Track		**15**	
See "Focus Area Tracks" [3]			
Total Hours		**51-54**	

1 BMA 801 Seminar needs to be repeated three times to meet the three credit hour requirement.

2 Must represent at least two different perspectives.

3 Must include at least one 700 level course.

Statistic Course Options

Option 1

Code	Title	Hours	Counts towards
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	
Total Hours		**6**	

Option 2

Code	Title	Hours	Counts towards
Option Two			
ST 512	Statistical Methods For Researchers II (R)	3	
Total Hours		**3**	

Focus Track Areas

Biological Sciences

Code	Title	Hours	Counts towards
Select five courses, minimum of one form each of the following:		**15**	
Cellular and Molecular Biology			
Genetics and Development			
Biophysical and Biomedical Sciences and Physiology			
Ecology and Evolution			
Total Hours		**15**	

Mathematical Methods

Code	Title	Hours	Counts towards
Select five courses in the following or co-major:		**15**	
Mathematics			
Statistics			
Operations Research			
Computer Studies			
Total Hours		**15**	

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Adjunct Faculty

John Edward Banks

Georgiy Bobashev

Brian Ernest Carlson

James W. Gilliam

Nicholas M. Haddad

Thomas D. Husmeier

Julia S. Kimbell

W. Owen McMillan III

Suzanne Marie Lenhart

Johnny T. Ottesen

Eric A. Stone

Biomathematics (Minor)

Plan Requirements

MS Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
Select two of the following:			
BMA 567	Modeling of Biological Systems		
BMA 771	Biomathematics I		
BMA 772	Biomathematics II		
Supporting Courses [1]		**6**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
Total Hours		**12**	

[1] In lieu of these two courses, the single course ST 512 Statistical Methods For Researchers II R may be taken

PhD Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**11**	
BMA 567	Modeling of Biological Systems		
BMA 771	Biomathematics I		
BMA 772	Biomathematics II		
BMA 801	Seminar		
Supporting Courses		**9**	
Select one quantitative biology course (500+ level)			
Select two courses in biology, statistics, mathematics, or biomath			
Total Hours		**20**	

Faculty

Full Professors

Kevin Gross

Mansoor Abbas Haider

Carol K. Hall

Jason M. Haugh

George R. Hess

Alun L. Lloyd

Sharon R. Lubkin

Spencer V. Muse

Mette Olufsen

Brian J. Reich

Seth M. Sullivant

Jeffrey L. Thorne

Hien Trong Tran

Zhaobang Zeng

Associate Professors

Randall Brian Langerhans

Cristina Lanzas

Charles Eugene Smith

Rosangela Sozzani

Assistant Professors

Belinda Sena Akpa

Kevin Bryant Flores

David Alan Rasmussen

Emeritus Faculty

William Reid Atchley

John William Bishir

Marlene L. Hauck

Gail G. McRae

Kenneth Hugh Pollock

Jim E. Riviere

Henry E. Schaffer

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Eric A. Stone

Chemistry

The Department of Chemistry offers programs of study leading to the Doctor of Philosophy and Master of Science degrees. These degrees are based on coursework and original research. Many research projects merge disciplines such as chemical/synthetic biology, biophysics/physics, computational science, informatics, photonics/photophysics and materials science with chemistry. General courses as well as advanced and special topics courses are offered.

Admission Requirements

Applicants should have an undergraduate degree in chemistry or in a closely related field with a strong chemistry background. A GPA of at least 3.0 in the sciences is needed for consideration. GRE General Test scores are not required. Admission decisions are made as completed applications are received. For most favorable consideration for the Fall term, all application materials should be received by January 15 (both domestic and international students).

Master's Degree Requirements

The Master of Science (M.S.) degree in chemistry is a research degree that requires six graduate courses, a minimum of 30 credit hours, and research leading to a thesis.

Doctoral Degree Requirements

In the doctoral program, emphasis is placed on original research and a comprehensive knowledge of one's chosen field.

Student Financial Support

Incoming graduate students are supported by departmental teaching assistantships. Outstanding applicants are eligible for supplemental fellowships during their first year of study. Research assistantships are normally available to second-, third-, and fourth-year students. The department also has fellowships for students interested in the area of electronic materials, biotechnology and pharmaceutical and synthetic organic chemistry, as well as travel funds to attend and deliver an oral presentation professional meeting(s).

Other Relevant Information

The Chemistry Department forms part of the College of Sciences. More than one dozen new faculty members have been added in the last ten

years, thereby greatly enhancing opportunities for graduate research especially in cutting edge interdisciplinary programs.

Degrees

- Chemistry (MS) (p. 723)
- Chemistry (PhD) (p. 725)
- Chemistry (Minor) (p. 726)

Faculty

Full Professors

Dimitris S. Argyropoulos

Edmond F. Bowden

Felix Nicholas Castellano

Stefan Franzen

Christopher B. Gorman

Jonathan S. Lindsey

James D. Martin

David C. Muddiman

Alexander A. Nevzorov

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Thomas Theis

Practice/Research/Teaching Professors

P. Brown

J. Feducia

M. Gallardo-Williams

A. Ison

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L. Petrovich

G. Rabah

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Myung H. Whangbo

Jerry L. Whitten

Adjunct Faculty

V. Bornemann

Chemistry (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
CH 610	Special Topics In Chemistry (Introduction to Graduate Studies)		
CH 601	Seminar (two semesters)		
CH 695	Master's Thesis Research		
CH 699	Master's Thesis Preparation		
Additional Courses		**18**	
See "Additional Courses" listed below			
Total Hours		**33**	

Additional Courses

Code	Title	Hours	Counts towards
Select a minimum of six recommended courses below: *		**18**	
Courses Analytical Division			
CH 727	Biological Mass Spectrometry	3	
CH 749	Analytical Spectroscopy	3	
Biorganic & Organic Division			
CH 721	Advanced Organic Chemistry I	3	
CH 725	Physical Methods in Organic Chemistry	3	
CH 755	Organic Reaction Mechanisms	3	
Inorganic Division			
CH 701	Advanced Inorganic Chemistry I: Structure and Bonding	3	
CH 795	Special Topics in Chemistry	1-6	
CH 721	Advanced Organic Chemistry I	3	
or CH 725	Physical Methods in Organic Chemistry		
or CH 737	Quantum Chemistry		
or CH 795	Special Topics in Chemistry		
Physical Division			
CH 737	Quantum Chemistry	3	
CH 730	Advanced Physical Chemistry	3	

* Additional courses will be approved in conjunction with the academic committee.

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Adjunct Faculty

V. Bornemann

Chemistry (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**63**	
CH 610	Special Topics In Chemistry (Introduction to Graduate Studies)		
CH 801	Seminar		
CH 895	Doctoral Dissertation Research		
CH 899	Doctoral Dissertation Preparation		
Additional Courses		**18**	
See "Additional Courses" listed below			
Total Hours		**81**	

Additional Courses

Code	Title	Hours	Counts towards
Select a minimum of six recommended courses below: *		**18**	
Courses Analytical Division			
CH 727	Biological Mass Spectrometry	3	
CH 749	Analytical Spectroscopy	3	
Biorganic & Organic Division			
CH 721	Advanced Organic Chemistry I	3	
CH 725	Physical Methods in Organic Chemistry	3	
CH 755	Organic Reaction Mechanisms	3	
Inorganic Division			
CH 701	Advanced Inorganic Chemistry I: Structure and Bonding	3	
CH 795	Special Topics in Chemistry	1-6	
CH 721	Advanced Organic Chemistry I	3	
or CH 725	Physical Methods in Organic Chemistry		
or CH 737	Quantum Chemistry		
or CH 795	Special Topics in Chemistry		
Physical Division			
CH 737	Quantum Chemistry	3	
CH 730	Advanced Physical Chemistry	3	

* Additional courses will be approved in conjunction with the academic committee.

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V. Bornemann

Chemistry (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
See "Recommended Courses" below			
Total Hours		**9**	

Recommended Courses

Code	Title	Hours	Counts towards
Select a minimum of three of the following courses:		**9**	
Courses Analytical Division			
CH 727	Biological Mass Spectrometry	3	
CH 749	Analytical Spectroscopy	3	
Biorganic & Organic Division			
CH 721	Advanced Organic Chemistry I	3	
CH 725	Physical Methods in Organic Chemistry	3	
CH 755	Organic Reaction Mechanisms	3	
Inorganic Division			

CH 701	Advanced Inorganic Chemistry I: Structure and Bonding	3
CH 795	Special Topics in Chemistry	1-6
CH 721	Advanced Organic Chemistry I	3
or CH 725	Physical Methods in Organic Chemistry	
or CH 737	Quantum Chemistry	
or CH 795	Special Topics in Chemistry	
Physical Division		
CH 737	Quantum Chemistry	3
CH 730	Advanced Physical Chemistry	3

* Additional courses will be approved in conjunction with the academic committee.

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William L. Switzer

William P. Tucker

Dennis W. Wertz

Myung H. Whangbo

Jerry L. Whitten

Adjunct Faculty

V. Bornemann

Climate Change and Society

Degrees

- Climate Change & Society (MR) (p. 728)

Full Professors

Jay Levine

Walter Robinson

Practice/Research/Teaching Professors

Roberto Javier Mera

Emeritus Faculty

Fredrick Semazzi

Climate Change & Society (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**19**	
MEA 517	Fundamentals of Climate Change Science		
GIS 510	Fundamentals of Geospatial Information Science and Technology		
MEA 518	Adaptation to Climate Change		
MEA 519	Barriers to Climate Change Literacy		
COM 579	Climate Change Communication		
PHI 816	Introduction to Research Ethics		
MEA 593	Special Topics in Atmospheric Science (Applied Climate Experience)		
Statistics Requirement		**3**	
Select one of the following:			
ST 511	Statistical Methods For Researchers I		
MEA 593	Special Topics in Atmospheric Science (Quantitative Analysis of Climate Change Science)		
Environmental Requirement		**3**	
Select one of the following:			
PA 550	Environmental Policy		
EA 505	Environmental Assessment Law & Policy		
PS 536	Global Environmental Law and Policy		
Elective Courses		**6**	
Select six credit hours of the following:			
AEC 519	Freshwater Ecology		

BAE 528	Biomass to Renewable Energy Processes
BAE 572	Irrigation and Drainage
BAE 576	Watershed Monitoring and Assessment
CE 578	Energy and Climate
COM 525	Group/Team Communication
COM 538	Risk Communication
COM 546	Nonprofit Marketing and Public Relations
COM 562	Communication and Social Change
CRD 703	Communication Networks
EA 501	Environmental Stressors
EA 502	Environmental Risk Assessment
EA 503	Environmental Exposure Assessment
EA 504	Environmental Monitoring and Analysis
EA 505	Environmental Assessment Law & Policy
ENG 508	Usability Studies for Technical Communication
FOR 531	Wildland Fire Science
FOR 575	Advanced Terrestrial Ecosystem Ecology
FW 730	Ethics in Fisheries and Wildlife Sciences
GIS 512	Introduction to Environmental Remote Sensing
GIS 515	Cartographic Design
GIS 520	Spatial Problem Solving
GIS 609	Geospatial Forum
MEA 540	Principles of Physical Oceanography
MEA 549	Principles of Biological Oceanography
NR 520	Watershed and Wetlands Hydrology
NR 571	Current Issues in Natural Resource Policy
PA 513	Public Organization Behavior
PA 550	Environmental Policy
PS 536	Global Environmental Law and Policy
Total Hours	**31**

Full Professors

Jay Levine

Walter Robinson

Practice/Research/Teaching Professors

Roberto Javier Mera

Emeritus Faculty

Fredrick Semazzi

Marine, Earth and Atmospheric Sciences

Graduate programs are offered in Atmospheric Science, Earth Science, and Marine Science. Within marine sciences the subdisciplines include: biological, chemical, geological and physical oceanography.

Admission Requirements

A Bachelor's degree with research experience or a Master's degree is required for entry into the Ph.D. program. A Bachelor's degree in a science, mathematics or engineering is required for entry into the M.S. program in Atmospheric science, Earth Science, and Biological, Chemical, Geological or Physical Oceanography. Undergraduate field camp is required of all students in the M.S. program in earth science; this requirement may be fulfilled before or after admission. An M.S. degree with a non-thesis option for students is available and admission to this option must be requested at the time of application.

Master's Degree Requirements

The M.S. degree requires a minimum of 30 credit hours. Specific course requirements are determined by the advisory committee of each student. However, MEA 601 Seminar is required of all thesis M.S. students no later than the third semester in residence. Marine science students are required to take core courses in two of the three subdisciplines other than their own.

Doctoral Degree Requirements

Specific courses are determined by the student's advisory committee. Registration in seminar, MEA 801, is required of all Ph.D. students no later than the fourth semester in residence. Marine science students are required to take core courses in all three subdisciplines other than their own; this requirement may be fulfilled at the M.S. level.

Student Financial Support

Research and teaching assistantships are available.

Other Relevant Information

Students are assigned initial advisors upon admission. It is the student's responsibility to secure the consent of a faculty member to serve as the permanent advisor who will chair or co-chair the advisory committee.

Degrees

- Marine, Earth, and Atmospheric Sciences (MS) (p. 731)
- Marine, Earth, and Atmospheric Sciences (PhD) (p. 733)
- Marine, Earth, & Atmospheric Sciences (Minor) (p. 735)
- Climate Adaptation (Certificate) (p. 739)

Faculty

Viney Pal Aneja

DelWayne R. Bohnenstiehl

David B. Eggleston

David Paul Genereux

Peter Jeurgen Harries

Ruoying He

Gary M. Lackmann

Elana L. Leithold

Jay Frederick Levine

Jing-pu Liu

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Nicholas Meskhidze

Helena Mitasova

Lewis Andrew Owen

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Markus Dirk Jan Petters

Walter A. Robinson

William J. Showers

Lian Xie

Sandra E. Yuter

Anantha Aiyyer

Paul Kevin Byrne

Christopher Lee Osburn

Astrid Schnetzer

Karl William Wegmann

Carli Arendt

Stuart Bishop

Magdalena Alyssa Ellis Curry

Catherine Van Wie Davis

Lily Hughes

Ethan Gordon Hyland

Sarah Larson

Ryan William Paerl

Andres Camilo Rey Sanchez

Arianna Soldati

Otis B. Brown

Curtis Congreve

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Charles Ernest Knowles

Satya Pal Singh Arya

Jerry M. Davis

David John DeMaster

Ronald Victor Fodor

John Crothers Fountain

James Patrick Hibbard

Thomas Sawyer Hopkins

Daniel Kamykowski

Leonard J. Langfelder

Leonard J. Pietrafesa

Sethu Raman

Allen J. Riordan

Dale A Russell

Ping-Tung Shaw

Edward F. Stoddard

Charles W. Welby,

Donna Lee Wolcott

Thomas G. Wolcott

William Howard Battye

Geoffrey Weszely Bell

Scott Anthony Braun

Michael Brennan

Subrahmanyam Bulusu

Brian A. Colle

Jeffrey Cunningham

Johannes Michael Leopold Dahl

Kathie Dello

David R. Easterling

Scott Howard Ensign

Troy Gilmore

Peter Hamilton

Russel S. Harmon

Barron Halton Henderson

Nam-Young Kang

David E. Kingsmill

Branko Kosovic

Emlyn Howard Koster

Benjamin Kravitz

Nicole Deneault LaDue

Romuald Lipcius

Huiqing Liu

David Mechem

Siddhartha Mitra

Maria Janeth Molina

Andrew Newell

Lester Perry

Sharon Phillips

Brandon Puckett

S. Trivikrama Rao

Joseph Rudek

Blake Schaeffer

Jenni Stanley

Robert Christopher Tacker

Susan White

Shaocai Yu

Yang Zhang

Marine, Earth, and Atmospheric Sciences (MS)

Degree Requirements

Graduate programs are offered in Atmospheric Science, Earth Science, and Marine Science. Specific course requirements are determined by the advisory committee of each student.

Students can choose focus area tracks from the following:

- Atmospheric Science Track (p. 731)
- Earth Science Track (p. 731)
- Marine Science Track (p. 732)

Degrees earned will be distributed as: "Master of Science in Marine, Earth, and Atmospheric Sciences" without track specifications.

Atmospheric Science Track

Code	Title	Hours	Counts towards
Seminar Course		**1**	
MEA 601	Seminar		
Area of Focus Courses [1]		**29**	
Courses in the "Area of Focus" are determined in conjunction with the academic committee			
Total Hours		**30**	

[1] MEA 601 Seminar is required of all thesis M.S. students no later than the third semester in residence.

Earth Science Track

Code	Title	Hours	Counts towards
Seminar Course [1]		**1**	
MEA 601	Seminar		
Area of Focus Courses		**29**	

Courses in the "Area of Focus" are determined in conjunction with the academic committee	
Total Hours	**30**

Marine Science Track

Within marine sciences the subdisciplines include:

- Biological Oceanography
- Chemical Oceanography
- Geological Oceanography
- Physical Oceanography

Code	Title	Hours	Counts towards
Core Courses		**12**	
MEA 540	Principles of Physical Oceanography		
MEA 549	Principles of Biological Oceanography		
MEA 570	Geological Oceanography		
MEA 573	Principles of Chemical Oceanography		
Seminar Course [1]		**1**	
MEA 601	Seminar		
Area of Focus Courses		**11**	
Courses in the "Area of Focus" are determined in conjunction with the academic committee			
Courses Outside Area of Focus		**6**	
"Courses Outside Area of Focus" are determined in conjunction with the academic committee			
Total Hours		**30**	

Faculty

Viney Pal Aneja

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Brandon Puckett

S. Trivikrama Rao

Joseph Rudek

Blake Schaeffer

Jenni Stanley

Robert Christopher Tacker

Susan White

Shaocai Yu

Yang Zhang

Marine, Earth, and Atmospheric Sciences (PhD)

Degree Requirements

Graduate programs are offered in Atmospheric Science, Earth Science, and Marine Science. Specific course requirements are determined by the advisory committee of each student.

Degrees earned will be distributed as: "Doctor of Philosophy in Marine, Earth, and Atmospheric Sciences" without track specifications.

Marine Science Track

Within marine sciences the subdisciplines include:

- Biological Oceanography
- Chemical Oceanography
- Geological Oceanography
- Physical Oceanography

Code	Title	Hours	Counts towards
Core Courses [1]		**12**	
MEA 540	Principles of Physical Oceanography		
MEA 549	Principles of Biological Oceanography		

MEA 570	Geological Oceanography	
MEA 573	Principles of Chemical Oceanography	
Seminar Course [2]		**1**
MEA 801	Seminar	
Area of Focus Courses		**50**
Courses in the "Area of Focus" are determined in conjunction with the academic committee		
Courses Outside Area of Focus		**9**
"Courses Outside Area of Focus" are determined in conjunction with the academic committee		
Total Hours		**72**

Earth Science Track

Code	Title	Hours	Counts towards
Seminar Course [2]		**1**	
MEA 801	Seminar		
Area of Focus Courses		**71**	
Courses in the "Area of Focus" are determined in conjunction with the academic committee			
Total Hours		**72**	

Atmospheric Science Track

Code	Title	Hours	Counts towards
Seminar Course [2]		**1**	
MEA 801	Seminar		
Area of Focus Courses [1]		**71**	
Courses in the "Area of Focus" are determined in conjunction with the academic committee			
Total Hours		**72**	

1 Marine science students are required to take core courses in all three subdisciplines other than their own; this requirement may be fulfilled at the M.S. level.

2 MEA 801 is required of all Ph.D. students no later than the fourth semester in residence.

Faculty

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Shaocai Yu

Yang Zhang

Marine, Earth, & Atmospheric Sciences (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Marine, Earth, and Atmospheric Sciences Courses

Code	Title	Hours	Counts towards
MEA 507	Discipline-based Education Research in the Geosciences	3	
MEA 510	Air Pollution Meteorology	3	
MEA 511	Introduction to Meteorological Remote Sensing	3	
MEA 514	Advanced Physical Meteorology	3	
MEA 515	Climate Dynamics	3	
MEA 517	Fundamentals of Climate Change Science	3	
MEA 518	Adaptation to Climate Change	3	
MEA 519	Barriers to Climate Change Literacy	3	
MEA 525	Introduction to Atmospheric Chemistry	3	
MEA 540	Principles of Physical Oceanography	3	
MEA 549	Principles of Biological Oceanography	3	
MEA 553	Estuarine Biogeochemistry	3	
MEA 554	Marine Physical-Biological Interactions	3	
MEA 562	Marine Sediment Transport	3	
MEA 568	Aquatic Microbiology	3	
MEA 570	Geological Oceanography	3	
MEA 573	Principles of Chemical Oceanography	3	
MEA 574	Advanced Igneous Petrology	3	
MEA 577	Electron Microprobe Analysis of Geologic Material	2	
MEA 579	Principles of Air Quality Engineering	3	
MEA 580	Air Quality Modeling and Forecasting	4	
MEA 581	Fluid Mechanics in Natural Environments	3	
MEA 582	Geospatial Modeling	3	
MEA 584	Mapping and Analysis Using UAS	3	
MEA 585	Physical Hydrogeology	3	
MEA 591	Special Topics in Marine Science	1-6	
MEA 592	Special Topics in Earth Sciences	1-6	
MEA 593	Special Topics in Atmospheric Science	1-6	
MEA 599	Regional Geology of North America	1-6	
MEA 601	Seminar	1	
MEA 611	Special Topics in Marine Sciences	1-6	
MEA 612	Special Topics in Earth Sciences	1-6	
MEA 613	Special Topics Atmospheric Sciences	1-6	
MEA 685	Master's Supervised Teaching	1-3	
MEA 690	Master's Examination	1-9	
MEA 693	Master's Supervised Research	1-9	
MEA 695	Master's Thesis Research	1-9	
MEA 696	Summer Thesis Research	1	
MEA 699	Master's Thesis Preparation	1-9	
MEA 700	Environmental Fluid Mechanics	3	

MEA 703	Atmospheric Aerosols	3
MEA 705	Dynamic Meteorology	3
MEA 707	Planetary Boundary Layer	3
MEA 708	Atmospheric Turbulence	3
MEA 710	Atmospheric Dispersion	3
MEA 712	Mesoscale Modeling	3
MEA 713	Mesoscale Dynamics	3
MEA 714	Atmospheric Convection	3
MEA 715	Dynamics of Mesoscale Precipitation System	3
MEA 716	Numerical Weather Prediction	3
MEA 717	Advanced Weather Analysis	3
MEA 719	Climate Modeling	3
MEA 721	Air-Sea Interaction	3
MEA 735	Fourier Analysis of Geophysical Data	3
MEA 741	Synpotic Physical Oceanography	3
MEA 743	Ocean Circulation	3
MEA 744	Dynamics of Shelf Circulation	3
MEA 752	Marine Plankton Ecology	3
MEA 759	Organic Geochemistry	3
MEA 760	Biogeochemistry	3
MEA 762	Marine Geochemistry	3
MEA 763	Isotope Geochemistry	3
MEA 779	Advanced Air Quality	3
MEA 785	Chemical Hydrogeology	3
MEA 788	Advanced Structural Geology	3
MEA 789	Topics In Appalachian Geology	3
MEA 790	Geotectonics	3
MEA 791	Advanced Special Topics in Marine Science	1-6
MEA 792	Advanced Special Topics in Earth Sciences	1-6
MEA 793	Advanced Special Topics in Atmospheric Science	1-6
MEA 796	Exploration And Engineering Geophysics	3
MEA 801	Seminar	1
MEA 810	Special Topics	1-6
MEA 811	Special Topics in Marine Sciences	1-6
MEA 812	Special Topics in Earth Sciences	1-6
MEA 813	Special Topics in Atmospheric Sciences	1-6
MEA 885	Doctoral Supervised Teaching	1-3
MEA 893	Doctoral Supervised Research	1-9
MEA 895	Doctoral Dissertation Research	1-9
MEA 896	Summer Dissertation Research	1
MEA 899	Doctoral Dissertation Preparation	1-9

Faculty

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Climate Adaptation (Certificate)

The Graduate Certificate in Climate Adaptation program at NC State University provides accredited, academic training in the emerging field of climate adaptation. The online, twelve credit program is designed to provide mid-career professionals and entry-level students with technological skills and specialization in climate adaptation. The certificate is a fully accredited credential and a potential path toward the Climate Adaptation degree program. Coursework includes Fundamentals of Climate Change Science, Climate Risk Analysis, Climate Communication and Introduction to Geographic Information Systems.

Admission Requirements

Applicants must meet one of the 3 following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study.
- Have a Master's degree.
- Be a degree student in good standing in a NC State University graduate program.

We recommend that students in a NC State University graduate program may apply after completing two of the courses required for the graduate certificate program with at least B grades. The graduate certificate program Director will manage the admissions process in consultation with the MEAS Director of Graduate Programs.

Provisional Admission

Applicants who do not meet the graduate certificate program requirements for full admission may be admitted provisionally based on the quality of their letters of recommendation and other criteria at the discretion of the Certificate Program Director and MEAS Director of Graduate Programs. Students who are admitted provisionally must maintain a 3.0 GPA in order to obtain full admission into the certificate program.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
MEA 517	Fundamentals of Climate Change Science	3	
MEA 518	Adaptation to Climate Change	3	
MEA 519	Barriers to Climate Change Literacy	3	
GIS 510	Fundamentals of Geospatial Information Science and Technology	3	
Total Hours		**12**	

Mathematics

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy in Mathematics and in Applied Mathematics. Students may opt for the Concentration in Computational Mathematics, which is attached to the program in applied mathematics. The Concentration in Interdisciplinary Mathematics (MAI) is available to Ph.D. students in either Mathematics or Applied Mathematics. It is not available to Masters Students. Joint research endeavors with industrial and governmental partners are facilitated and encouraged. The Department of Mathematics also offers a Certificate.

Admissions Requirements

Applicants for admission should have an undergraduate or Master's degree in mathematics or applied mathematics. This should include courses in advanced calculus, analysis, modern algebra and linear algebra. Applicants with degrees in other subjects may be admitted but may be required to take certain undergraduate courses in mathematics without receiving graduate credit. GRE general scores are required. The GRE Subject Test in Mathematics is not required but a good score can be a positive factor in admission.

Master of Science Requirements

The M.S. degree requires a minimum of 30 credit hours with courses chosen to satisfy certain requirements to cover material from three different areas in the department, and some level of depth of material.

Ph.D. Requirements

The Ph.D. requires a minimum of 72 credit hours. A student will typically take 50-60 semester hours of course credits for the Ph.D. The written

preliminary examination consists of examinations in three areas of mathematics chosen by the student from 12 possibilities. The research dissertation should represent a substantial contribution to an area of mathematics or its applications.

Student Financial Support

Teaching assistantships and some research assistantships are available. Teaching assistants benefit from a structured program of training in university-level teaching.

Degrees

- Mathematics (MS) (p. 741)
- Mathematics (PhD) (p. 744)
- Mathematics (PhD): Interdisciplinary Mathematics Concentration (p. 746)
- Mathematics (Minor) (p. 748)
- Mathematics (Certificate) (p. 752)

Faculty

Full Professors

Bojko Nentchev Bakalov

Alina Emil Chertock

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Jo-Ann D. Cohen

Patrick Louis Combettes

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Jessica Loock Matthews

J. Ottesen

Mathematics (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select one course from each of the following categories:			
Continuous Mathematics			
MA 513	Introduction To Complex Variables		
MA 515	Analysis I		
MA 531	Dynamic Systems and Multivariable Control I		
MA 532	Ordinary Differential Equations I		
MA 534	Introduction To Partial Differential Equations		
MA 546	Probability and Stochastic Processes I		
MA 551	Introduction to Topology		
MA 555	Introduction to Manifold Theory		
Discrete Mathematics			

MA 505	Linear Programming	
MA 520	Linear Algebra	
MA 521	Abstract Algebra I	
MA 523	Linear Transformations and Matrix Theory	
MA 524	Combinatorics I	
MA 526	Mathematical Analysis II	
Computational Mathematics		
MA 522	Computer Algebra	
MA 540	Uncertainty Quantification for Physical and Biological Models	
MA 565	Graph Theory	
MA 573	Mathematical Modeling of Physical and Biological Processes I	
MA 580		
In Depth Requirement Courses		**12**
Select two course sequences, or one group of three thematically linked courses, approved in conjunction with the academic committee		
Additional Courses		**9**
"Additional Courses" are approved in conjunction with the academic committee to meet 30 total hours		
Total Hours		**30**

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Full Professors

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Mathematics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
See "Required Courses by Category" listed below			
Additional Courses *		**63**	
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours			
Total Hours		**72**	

* At least 30 credit hours of MA coursework must be at the graded 500- and 700-level.

Required Coursework by Category

Code	Title	Hours	Counts towards
Select one course from each of the following categories:		**9**	
Continuous Mathematics			
MA 513	Introduction To Complex Variables	3	
MA 515	Analysis I	3	
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 532	Ordinary Differential Equations I	3	
MA 534	Introduction To Partial Differential Equations	3	
MA 546	Probability and Stochastic Processes I	3	
MA 551	Introduction to Topology	3	
MA 555	Introduction to Manifold Theory	3	
Discrete Mathematics			
MA 505	Linear Programming	3	
MA 520	Linear Algebra	3	
MA 521	Abstract Algebra I	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 524	Combinatorics I	3	
MA 526	Mathematical Analysis II	3	
Computational Mathematics			
MA 522	Computer Algebra	3	
MA 540	Uncertainty Quantification for Physical and Biological Models	3	
MA 565	Graph Theory	3	
MA 573	Mathematical Modeling of Physical and Biological Processes I	3	
MA 580		3	

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Mathematics (PhD): Interdisciplinary Mathematics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
See "Required Courses by Category" listed below			
Additional Courses [1, 2]		**63**	
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours			
Total Hours		**72**	

1 At least 30 credit hours of MA coursework must be at the graded 500- and 700-level.

2 At least two courses should be from another discipline. One of these courses may be cross-listed with MA.

Required Coursework by Category

Code	Title	Hours	Counts towards
Select one course from each of the following categories:		**9**	
Continuous Mathematics			
MA 513	Introduction To Complex Variables	3	
MA 515	Analysis I	3	
MA 531	Dynamic Systems and Multivariable Control I	3	
MA 532	Ordinary Differential Equations I	3	
MA 534	Introduction To Partial Differential Equations	3	
MA 546	Probability and Stochastic Processes I	3	
MA 551	Introduction to Topology	3	
MA 555	Introduction to Manifold Theory	3	
Discrete Mathematics			
MA 505	Linear Programming	3	
MA 520	Linear Algebra	3	
MA 521	Abstract Algebra I	3	
MA 523	Linear Transformations and Matrix Theory	3	
MA 524	Combinatorics I	3	
MA 526	Mathematical Analysis II	3	
Computational Mathematics			
MA 522	Computer Algebra	3	
MA 540	Uncertainty Quantification for Physical and Biological Models	3	
MA 565	Graph Theory	3	
MA 573	Mathematical Modeling of Physical and Biological Processes I	3	
MA 580		3	

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Mathematics (Minor)

Plan Requirements

Master's Minor

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select at least three Graduate-level MA courses approved in conjunction with the academic committee [1, 2]			
Total Hours		**9**	

PhD Minor

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select any 500- or 700-level MA course approved in conjunction with the academic committee [1]			
Total Hours		**12**	

1 Student must maintain an average 3.0 GPA for courses to count toward a Mathematics minor.

2 At least six credit hours must be taken at the letter graded 500- or 700-level.

Graduate Mathematics Courses

Code	Title	Hours	Counts towards
MA 501	Advanced Mathematics for Engineers and Scientists I	3	
MA 502	Advanced Mathematics for Engineers and Scientists II	3	
MA 504	Introduction to Mathematical Programming	3	
MA 505	Linear Programming	3	
MA 507	Survey of Real Analysis	3	
MA 508	Survey of Geometry	3	
MA 509	Survey of Abstract Algebra	3	
MA 510	Selected Topics In Mathematics For Secondary Teachers	1-6	

MA 511	Introduction to Advanced Calculus	3
MA 512	Advanced Calculus	3
MA 513	Introduction To Complex Variables	3
MA 514	Foundations of Cryptography	3
MA 515	Analysis I	3
MA 518	Geometry of Curves and Surfaces	3
MA 520	Linear Algebra	3
MA 521	Abstract Algebra I	3
MA 522	Computer Algebra	3
MA 523	Linear Transformations and Matrix Theory	3
MA 524	Combinatorics I	3
MA 526	Mathematical Analysis II	3
MA 528		3
MA 531	Dynamic Systems and Multivariable Control I	3
MA 532	Ordinary Differential Equations I	3
MA 534	Introduction To Partial Differential Equations	3
MA 537	Nonlinear Dynamics and Chaos	3
MA 540	Uncertainty Quantification for Physical and Biological Models	3
MA 544	Computer Experiments In Mathematical Probability	3
MA 546	Probability and Stochastic Processes I	3
MA 547	Stochastic Calculus for Finance	3
MA 548	Monte Carlo Methods for Financial Math	3
MA 549	Financial Risk Analysis	3
MA 551	Introduction to Topology	3
MA 555	Introduction to Manifold Theory	3
MA 561	Set Theory and Foundations Of Mathematics	3
MA 565	Graph Theory	3
MA 573	Mathematical Modeling of Physical and Biological Processes I	3
MA 574	Mathematical Modeling of Physical and Biological Processes II	3
MA 580		3
MA 583	Introduction to Parallel Computing	3
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA 591	Special Topics	1-6
MA 685	Master's Supervised Teaching	1-3
MA 706	Nonlinear Programming	3
MA 708	Integer Programming	3
MA 715	Measure Theory and Integration	3
MA 716	Advanced Functional Analysis	3
MA 719	Vector Space Methods in System Optimization	3
MA 720	Lie Algebras	3
MA 721	Abstract Algebra II	3
MA 722	Computer Algebra II	3

MA 723	Theory of Matrices and Applications	3
MA 724	Combinatorics II	3
MA 725	Lie Algebra Representation Theory	3
MA 731	Dynamic Systems and Multivariable Control II	3
MA 732	Ordinary Differential Equations II	3
MA 734	Partial Differential Equations	3
MA 746	Introduction To Stochastic Processes	3
MA 747	Probability and Stochastic Processes II	3
MA 748	Stochastic Differential Equations	3
MA 753	Algebraic Topology	3
MA 755	Introduction to Riemannian Geometry	3
MA 766	Network Flows	3
MA 771	Biomathematics I	3
MA 772	Biomathematics II	3
MA 773	Stochastic Modeling	3
MA 774	Partial Differential Equation Modeling in Biology	3
MA 780	Numerical Analysis I	3
MA 784	Nonlinear Equations and Unconstrained Optimization	3
MA 785	Numerical Solution of Ordinary Differential Equations	3
MA 788	Numerical Nonlinear Partial Differential Equations	3
MA 790	Advanced Special Topics System Optimization	1-6
MA 791	Special Topics In Real Analysis	1-6
MA 792	Special Topics In Algebra	1-6
MA 793	Special Topics In Differential Equations	1-6
MA 796	Special Topics In Combinatorial Analysis	1-6
MA 797	Special Topics In Applied Mathematics	1-6
MA 798	Special Topics In Numerical Analysis	1-6
MA 810	Special Topics	1-6
MA 812	Special Topics in Mathematical Programming	1-6
MA 816	Advanced Special Topics Sys Opt	1-6

Faculty

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N. Rose

Stephen Schecter

Jeffrey Scott Scroggs

James Francis Selgrade

C. Siewert

Robert Silber

Michael F. Singer

R. White

Adjunct Faculty

Scott Christopher Batson

Jonathan David Hauenstein

Patricia L. Hersh

John Lavery

Jordan E. Massad

Jessica Loock Matthews

J. Ottesen

Mathematics (Certificate)

The Graduate Certificate in Mathematics is a one-year program that focuses on two groups of students. It is designed for students who have some mathematical training but do not have a full bachelor's degree in mathematics. It also targets students who have a bachelor's degree in mathematics but do not feel they are ready for graduate school.

The goal of the certificate is to prepare and motive students through courses and careful mentoring. The program will deepen and broaden students' understanding of mathematics, the mathematics profession, and the mathematical community. Students will learn how the mathematics discipline can solve significant problems for government, industry, other scientists, and ultimately, society at large.

Admissions

Application to the program requires an online application form, three (3) letters of recommendation (two need to be academic), transcripts of all academic work after high school, and a written statement. GREs are highly desirable but not required for admission. Admission will be on a competitive basis.

Requirements

Students take a combination of graduate and undergraduate mathematics courses that are tailored to the individual student. The certificate requires 12 hours of mathematics courses, taken for a grade, and to be taken at NC State. There is no specific list of courses for the certificate.

Of the 12 hours, three (3) hours may be at the 400 level with prior approval of the Director of Graduate Programs. The other nine (9) hours will be at the 500 level or above. Students must take at least two (2) courses per semester to remain in good standing. A grade of C- is required for a course to count toward the certificate. A 3.00 GPA is required to earn the certificate.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses *		**12**	
	One course may me taken at the 400-level with DGP approval		
	A minimum of three courses must be taken at the 500- or 700-level		
Total Hours		**12**	

* Students must maintain an average 3.0 GPA in all MA courses.

Physics

Research opportunities in theoretical/computational physics are available in astrophysics, biophysics, chaos, condensed matter, nanoscience/nanomaterials, nuclear and particle physics, quantum computing, and relativity. Research opportunities in experimental physics are available in astronomy, atomic and molecular physics, biophysics, emergent phenomena, materials physics, nanoscale science, nonlinear systems, nuclear and particle physics, optics, soft-condensed-matter physics and technology, and surface physics.

Degrees earned will be distributed as: "Master of Science" and "Doctor of Physics" without specialization specifications.

Admission Requirements

Bachelor's degree in physics or equivalent and related. General GRE and the GRE Physics subject test are accepted, but not required.

Master's Degree Requirements

A minimum of 30 credit hours beyond the Bachelor's degree with mastery of aspects of the physics curriculum. There are 2 options:

- Option A: Earning 24 credit hours of courses, 6 of research, writing a dissertation, and passing an oral exam;
- Option B: Earning 30 credit hours of courses and passing the physics qualifying exam.

Doctoral Degree Requirements

A minimum of 72 credit hours beyond the Bachelor's degree (54 with an incoming Master's); demonstrating mastery of the core physics curriculum as evidenced by passing the qualifying exam; demonstrating mastery of research in a subspecialty of physics by passing appropriate

elective courses, planning a research topic, passing an oral preliminary exam, writing a dissertation, and passing a final oral defense.

Student Financial Support

Graduate teaching assistantships are available for new and continuing students. Research assistantships are available to continuing students and occasionally to new students. More than 95% of students are supported by assistantships.

Degrees

- Physics (MS) (p. 754)
- Physics (PhD) (p. 755)
- Physics (Minor) (p. 757)

Faculty

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Physics (MS)

Master of Science Degree Requirements

Thesis (Option A) Requirements

Code	Title	Hours	Counts towards
Letter-Graded Courses		**24**	
Select six PY 500-level / 700-level courses approved in conjunction with the academic committee [1]			
Research Course		**6**	
PY 695	Master's Thesis Research (Optional)		
Total Hours		**30**	

Non-Thesis (Option B) Requirements

Code	Title	Hours	Counts towards
Letter-Graded Courses		**18**	
Select six PY 500-level / 700-level courses approved in conjunction with the academic committee [1,2]			
Department Qualifying Exam		**12**	
Students must pass a Department Qualifying Exam from the following courses:			
PY 721	Statistical Physics I		
PY 782	Quantum Mechanics II		
PY 783	Advanced Classical Mechanics I		
PY 785	Advanced Electricity and Magnetism I		
Total Hours		**30**	

1 Excludes: PY 501 Quantum Physics I, PY 511 Mechanics I, and PY 514 Electromagnetism I.

2 Students may opt to select a minor, by which three graded courses from other departments will be accepted as determined in conjunction with the academic committee.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Physics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Background Coursework			
PY 781	Quantum Mechanics I		
Core Courses		**12**	
Select four PY 700-level courses approved in conjunction with the academic committee [1]			
Qualifying Exams		**12**	
PY 721	Statistical Physics I		
PY 782	Quantum Mechanics II		
PY 783	Advanced Classical Mechanics I		
PY 785	Advanced Electricity and Magnetism I		
Elective Courses		**12**	
"Elective Courses" may include PY 500-level and 700-level courses, physics-related courses in other departments, or courses required for a minor			
Additional Courses		**36**	
Research Courses			
PY 890	Doctoral Preliminary Examination		

PY 895	Doctoral Dissertation Research [2]	
Dissertation		
PY 899	Doctoral Dissertation Preparation	
Total Hours		**72**

1 Excludes PY 781 & PY 785, but may include: PY 721 Statistical Physics I, PY 782 Quantum Mechanics II, PY 783 Advanced Classical Mechanics I.

2 42 credit hours of research are required for a PhD; however, only 24 are required for students with a MS.

Faculty

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Physics (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Students must take a minimum of 15 hours of PY coursework approved in conjunction with the Academic Committee			
Total Hours		**15**	

Additional Requirements

- Minimum GPA of 2.9
- At least one faculty from the Department of Physics on the Thesis Committee

Faculty

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Statistics

Admission Requirements

For the in-person Master program, knowledge of multivariable calculus (comparable to MA 242 at NCSU) and matrix algebra (comparable to MA 305/MA 405 at NCSU) are the minimal requirements for entry. For the PhD program, students are expected to have a good foundation in the material covered in the core courses (ST 701, ST 702, ST 703, ST 704 and ST 705), even if their master's degree was received at another institution. Some students with previous master's degrees find it useful to take these courses at NCSU. However, this tends to lengthen the time to degree. Students are also expected to have had a course comparable to MA 425 Mathematical Analysis I at NCSU.

Students may apply to either the Master or PhD program directly from a Bachelor's degree. GRE General and Subject Tests scores are NOT required for admission to the Statistics Graduate Programs including both master and PhD programs. Due to the differences in student backgrounds, there is a separate admissions process for the online and in-person programs. A completed application consists of:

1. An online application form;
2. A transcript from each postsecondary institution;
3. Three letters of recommendation;
4. English proficiency scores (TOEFL or IELTS);
5. A written personal statement, which should not exceed two pages and should describe the applicant's academic and career goals as well as special interests in the area of statistics;
6. A resume or curriculum vita;
7. An application fee.

Students wishing to pursue the Ph.D. degree: Apply directly to the Ph.D. program. The master's program is not an intermediate step in that path. Ph.D. applicants are admitted only in the fall semester. Complete applications received by **December 15** will receive highest priority for admission and financial aid. Applications received later than February 15 will rarely be considered.

Students wishing to obtain only a master's degree (not as a route to the Ph.D.):

1. Applicants to the in-person master's degree may choose to start in the summer (late May) or in the fall (August). The summer session courses are offered online, so students would not be required to attend classes on campus until fall. The summer enrollment is only for students who are already in the United States. Fall enrollment is often the best choice for international students.
2. Applicants for the online master's degree are accepted throughout the year and can start any semester.

Priority is given to applications received by **January 15.** The final deadline is **March 25.** No offers of financial support are provided to master's students.

Master's Degree Requirements

All Master of Statistics degrees require a minimum of 30 semester hours. This includes 21 hours of common coursework: ST 517 Applied Statistical Methods I & ST 518 Applied Statistical Methods II, ST 501 Fundamentals of Statistical Inference I & ST 502 Fundamentals of Statistical Inference II, ST 503 Fundamentals of Linear Models and Regression, ST 542 Statistical Practice, and ST 555 Statistical Programming I. Each specific concentration will have additional requirements and/or electives to reach the minimum credit hours. These requirements are listed on each concentration page, listed below:

- Biostatistics (p. 761)
- Distance Education Track (p. 762) (Online)
- Environmental Statistics (p. 764)
- Financial (p. 765)
- Statistical Genetics (p. 766)

Doctoral Degree Requirements

Students that join our doctoral program with a Master of Statistics from another university are required to have a minimum of 54 credit hours in their doctoral Plan of Work (POW). Students who receive their master's degree from NC State must have a minimum of 72 credit hours on the master's and Ph.D. POWs combined. The POW may include research credit hours (ST 895); however, students are required to take 24 hours of coursework consisting of core courses, a consulting course, and electives as detailed on the degree requirements page (p. 769).

Student Financial Support

Departmental assistantships and fellowships are awarded to students in the Ph.D. program each year on a competitive basis.

Other Relevant Information

With a large graduate faculty representing virtually all major statistical specializations, the department is recognized as a world leader in graduate education and research in statistics. The Department provides a dynamic environment for teaching, core research and collaborative research across disciplines, with formal program concentrations in biostatistics, bioinformatics, environmental, financial and mathematical statistics.

Degrees

- Statistics (MR) (p. 760)
- Statistics (MR): Biostatistics Concentration (p. 761)
- Statistics (MR): Distance Track (p. 762)
- Statistics (MR): Environmental Statistics Concentration (p. 764)
- Statistics (MR): Financial Concentration (p. 765)
- Statistics (MR): Statistical Genetics Concentration (p. 766)
- Statistics (MS) (p. 768)
- Statistics (PhD) (p. 769)
- Statistics (Minor) (p. 771)
- Applied Statistics and Data Management (Certificate) (p. 772)
- Statistics Education (Certificate) (p. 772)

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Statistics (MR)

Master of Statistics Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		
Elective Courses		**9**	
Select nine credit hours of any ST course or ST cross-listed course at either the 500-level or 700-level *			
Total Hours		**30**	

* "Elective Courses" exclude "Core Courses", ST 507, ST 508, ST 511, ST 512, ST 513, ST 514, ST 515, and ST 516.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Alison Anne Motsinger-Reif

Eric A. Stone

Yichao Wu

Statistics (MR): Biostatistics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine credit hours of the following:			
ST 520	Statistical Principles of Clinical Trials		
ST 537	Applied Multivariate and Longitudinal Data Analysis		
ST 744	Categorical Data Analysis		
ST 745	Analysis of Survival Data		
Total Hours		**30**	

Faculty

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Statistics (MR): Distance Track

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 517	Applied Statistical Methods I		
ST 518	Applied Statistical Methods II		
ST 555	Statistical Programming I		
or ST 558	Data Science for Statisticians		
ST 542	Statistical Practice		
Additional Online Coursework		**9**	

Online coursework will be selected in conjunction with the academic committee	
Total Hours	**30**

Faculty

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Eric A. Stone

Yichao Wu

Statistics (MR): Environmental Statistics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		

Concentration Requirements

Code	Title	Hours	Counts towards
Statistics Elective Courses		**3**	
Select three credit hours of the following:			
ST 533/733	Applied Spatial Statistics		
ST 711	Design Of Experiments		
ST 534	Applied Time Series		
ST 537	Applied Multivariate and Longitudinal Data Analysis		
ST 744	Categorical Data Analysis		
ST 745	Analysis of Survival Data		
Supporting Elective Courses		**6**	
"Supporting Elective Courses" are approved in conjunction with the academic committee *			
Total Hours		**30**	

* Elective courses can fall within the following subjects: Environmental Policy, Economics, Epidemiology, Toxicology/Risk Assessment, Mathematics, MEAS, GIS, Botany & Ecology, Biomathematics, and Zoology.

Faculty

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Yichao Wu

Statistics (MR): Financial Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
ECG 528	Options and Derivatives Pricing		
MA 547	Stochastic Calculus for Finance		
Select three credit hours of the following:			
ST 534	Applied Time Series		
ST 540	Applied Bayesian Analysis		
ST 711	Design Of Experiments		
ST 537	Applied Multivariate and Longitudinal Data Analysis		
ST 744	Categorical Data Analysis		
Total Hours		**30**	

Faculty

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Statistics (MR): Statistical Genetics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		

Concentration Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select one of the following:			
ST 520	Statistical Principles of Clinical Trials		
ST 540	Applied Bayesian Analysis		
ST 711	Design Of Experiments		
ST 744	Categorical Data Analysis		
ST 745	Analysis of Survival Data		
Select six credit hours of the following:			
ST 721	Genetic Data Analysis		
ST 590	Special Topics (Introduction to Bioinformatics)		
ST 590	Special Topics (Bioinformatics II)		
GN 703	Population and Quantitative Genetics		
ST/GN 756	Computational Molecular Evolution		
ST/GN 757	Quantitative Genetics Theory and Methods		
Total Hours		**30**	

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Statistics (MS)

Degree Requirements

Students who are admitted into the Master of Statistics program and choose to complete a thesis will be moved into the Master of Science in Statistics. The degree requirements completed for the Master of Statistics will be applied toward the Master of Science.

Code	Title	Hours	Counts towards
Core Courses		**21**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ST 503	Fundamentals of Linear Models and Regression		
ST 542	Statistical Practice		
ST 555	Statistical Programming I		
ST 517 & ST 518	Applied Statistical Methods I and Applied Statistical Methods II		
Elective Courses		**3-6**	
Select 3-6 credit hours of any ST course or ST cross-listed course at either the 500-level or 700-level *			
Thesis		**3-6**	
ST 695	Master's Thesis Research		
Total Hours		**30**	

* "Elective Courses" exclude "Core Courses", ST 507, ST 508, ST 511, ST 512, ST 513, ST 514, ST 515, and ST 516.

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Statistics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Course Work		**12**	
ST 779	Advanced Probability for Statistical Inference		
ST 793	Advanced Statistical Inference		
ST 758	Computation for Statistical Research		
ST 841	Statistical Consulting [1]		
Ethics Sequence			
ST 810 & PHI 816	Advanced Topics in Statistics and Introduction to Research Ethics (Ethics in Statistics)		
Core Elective Courses		**9**	
Select nine credit hours of the following:			
ST 732	Longitudinal Data Analysis		
ST 733	Spatial Statistics		
ST 740	Bayesian Inference and Analysis		
ST 746	Introduction To Stochastic Processes		
ST 790	Advanced Special Topics		
Supporting Elective Courses		**3**	
Select a minimum of three credit hours of coursework approved in conjunction with the academic committee [2]			

Additional Courses	**48**
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours [3]	
Total Hours	**72**

1. Unless student has taken ST 542 Statistical Practice
2. A 500-level or 700-level course in either statistics or another department with material relevant to the student's plan of work. Examples include ST 520, ST 733, ST 744 and ST 745.
3. Additional courses may include ST 895 and courses taken from a Master of Statistics or Master of Science in Statistics degree at NCSU.

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Statistics (Minor)

Plan Requirements

MS Student

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select a two course sequence from group one or two			
Select three credit hours from another group or other 500/700 ST courses			
Total Hours		**9**	

PhD Student

Code	Title	Hours	Counts towards
Required Courses		**18**	
Select one course sequence from group one			
Select one course sequence from group two			
Select six credit hours of 500/700 ST courses not in groups 1 or 2			
Total Hours		**18**	

Groups

Code	Title	Hours	Counts towards
Group One: Sequence in Applied Statistics			
ST 507 & ST 508	Statistics For the Behavioral Sciences I and Statistics For the Behavioral Sciences II		
ST 511 & ST 512	Statistical Methods For Researchers I and Statistical Methods For Researchers II		
ST 515 & ST 516	Experimental Statistics for Engineers I and Experimental Statistics For Engineers II		
ST 513 & ST 514	Statistics for Management and Social Sciences I and Statistics For Management and Social Sciences II		
Group Two: Sequence in Probability & Mathematical Statistics			
ST 501 & ST 502	Fundamentals of Statistical Inference I and Fundamentals of Statistical Inference II		

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Applied Statistics and Data Management (Certificate)

In the Graduate Certificate in Applied Statistics and Data Management, students will learn statistical methods and how to apply them in real world settings and about statistical programming techniques that are required for managing data in a typical workplace environment.

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ST 555	Statistical Programming I		
ST 556	Statistical Programming II		
or ST 558	Data Science for Statisticians		
ST 511	Statistical Methods For Researchers I *		
or ST 513	Statistics for Management and Social Sciences I		
ST 512	Statistical Methods For Researchers II *		
or ST 514	Statistics For Management and Social Sciences II		
Total Hours		**12**	

* The course sequence ST 511 and ST 512 is similar to that of ST 513 and ST 514. The main difference is that ST 511 and ST 512 focus more heavily on analysis of designed experiments, where ST 513 and ST 514 focus more heavily on the analysis of observational data.

- The certificate will be earned by successful completion of four courses listed above with an average GPA of at least 3.0.

Statistics Education (Certificate)

In the Graduate Certificate in Statistics Education, students will learn statistical concepts, methods, and pedagogical techniques for teaching

these statistical topics at the college (or high school) level. The emphasis of the program is on the effective use of modern technology for teaching statistics. The courses required for this graduate certificate are listed below.

- Statistical Methods I: ST 511 (or ST 513)
- Statistical Methods II: ST 512 (or ST 514)
- Teaching and Learning of Statistical Thinking: ST 519
- Teaching Statistics with Technology: ST 557

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Requirements

The certificate will be earned by successful completion of four courses listed above with an average GPA of at least 3.0.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
ST 519	Teaching and Learning of Statistical Thinking		
ST 557	Using Technology to Teach Statistics		
Total Hours		**12**	

Toxicology

The Toxicology Program provides course work and research training to prepare prospective toxicologists and environmental health scientists for careers in academia, government, and industry. Research in the program spans an array of topics ranging from the molecular to population level consequences of toxicant exposure. Areas of research excellence within the program include elucidating relationships among cell signaling processes and stressor-induced disease and toxicity, establishing mechanisms of system-specific toxicity, using physiological and genomic approaches to understand differences in species and individual susceptibility to environmental contaminants, and unraveling gene-environment interactions. Some specific research areas include: apoptosis, endocrine disruption, trace metal bioaccumulation and detoxification, oxidative stress/gene regulation/cell toxicity, asthma and lung fibrosis, cancer and mutagenesis, ecotoxicology, developmental abnormalities, chemical exposure assessment and environmental epidemiology. Some examples of the types of environmental agents that are being investigated include chemical carcinogens, trace metals, pesticides, particulates metals, endocrine disruptors, nanoparticles and UVB radiation.

Admission Requirements

Prospective students should have a strong background in the biological and physical sciences with a minimum undergraduate grade point average of 3.0 (on a 4.0 scale) and a minimum Quantitative GRE score in the 70th percentile. GRE subject tests are not required. International students whose primary language is not English must submit TOEFL scores. A written statement should describe the applicants academic and career goals as well as their area of interest. All applications are reviewed by an admissions committee. Students are encouraged to submit applications no later than December 15 for Fall admission.

Master of Science Degree Requirements

The M.S. is a research-oriented degree requiring a minimum of 30 credit hours and a written thesis. At least 20 credit hours must be graduate-level courses and a core curriculum is required.

Master of Toxicology Degree Requirements

The MTOX degree is a non-research degree designed for those interested in pursuing non-research careers in toxicology and environmental health science, and/or working professionals seeking to further their education and advance their careers. To accommodate working professionals the MTOX degree can be pursued on a part-time basis. A minimum of 30 credit hours is required, with at least 14 credit hours in toxicology courses.

Doctoral Degree Requirements

The Ph.D. program is designed to train students to become independent scholars capable of conducting unsupervised and original research. Students enroll in a core curriculum similar to that of the M.S. degree and additional courses as determined by his/her advisory committee. Normally a total of 72 credit hours is required, with the majority of these credits being dissertation research. Students must pass both a written and oral preliminary exam prior to advancing to Ph.D. candidacy. A doctoral dissertation presenting the students original research is written and defended in a final oral examination.

Student Financial Support

Financial assistance is available for qualified applicants through traineeships, fellowships, teaching assistantships and research assistantships.

Other Relevant Information

Students pursuing either the M.S. or Ph.D. degree may elect to specialize in General Toxicology, Environmental Toxicology, or Molecular and Cellular Toxicology. More details can be obtained on the Environmental and Molecular Toxicology web site.

Degrees

- Toxicology (MR) (p. 774)
- Toxicology (MS) (p. 775)

- Toxicology (PhD) (p. 776)
- Toxicology (Minor) (p. 778)

Faculty

Full Professors

Ronald E. Baynes

James C. Bonner

Matthew Breen

David Buchwalter

William Gregory Cope

Jane A. Hoppin

Cathrine Hoyo

Michael Hyman

Detlef R. Knappe

Seth William Kullman

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Michael S. Bereman

Michael Anthony Cowley

Denis Fourches

Kurt Marsden

Practice/Research/Teaching Professors

Jonathan Hall

David Allen Skaar

Elizabeth E. A. Thompson

Toxicology (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**15**	
TOX 701	Fundamentals of Toxicology		
TOX 710	Molecular and Biochemical Toxicology		
TOX 715	Environmental Toxicology		
TOX 601	Toxicology Seminar		
TOX 620	Special Problems		
GN 701	Molecular Genetics		
or CBS 770	Cell Biology		
Elective Courses		**15**	
"Elective Courses" are approved in conjunction with the academic committee to meet 30 total hours			
Total Hours		**30**	

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David Michael Reif

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Yihui Zhou

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Michael Anthony Cowley

Denis Fourches

Kurt Marsden

Practice/Research/Teaching Professors

Jonathan Hall

David Allen Skaar

Elizabeth E. A. Thompson

Toxicology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**21**	
TOX 701	Fundamentals of Toxicology		
TOX 710	Molecular and Biochemical Toxicology		
TOX 715	Environmental Toxicology		
TOX 601	Toxicology Seminar		
TOX 620	Special Problems (Responsibility in Science)		
TOX 695	Master's Thesis Research		
GN 701	Molecular Genetics		
or CBS 770	Cell Biology		
Elective Courses		**9**	
"Elective Courses" are approved in conjunction with the academic committee to meet 30 total hours			
Total Hours		**30**	

Faculty

Full Professors

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James C. Bonner

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Seth William Kullman

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Toxicology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**33**	
TOX 701	Fundamentals of Toxicology		
TOX 710	Molecular and Biochemical Toxicology		
TOX 715	Environmental Toxicology		
TOX 801	Toxicology Seminar (enroll every semester)		
TOX 820	Special Problems In Toxicology (Lab Rotations)		
TOX 820	Special Problems In Toxicology (Responsible Conduct of Research)		
TOX 820	Special Problems In Toxicology (Professional Development)		
ST 511	Statistical Methods For Researchers I (or equivalent)		
GN 701	Molecular Genetics		
CBS 770	Cell Biology		
TOX 895	Doctoral Dissertation Research		
Elective Courses		**39**	
See "Elective Courses" listed below			
Total Hours		**72**	

Elective Courses

Code	Title	Hours	Counts towards
"Elective Courses" are approved in conjunction with the academic committee to meet 72 total hours*		**39**	
TOX 704	Chemical Risk Assessment		
CBS 771	Cancer Biology		
BIO 588	Neurobiology		
BIT 510	Core Technologies in Molecular and Cellular Biology		
BIT 562	Gene Expression Analysis: Microarrays		
BIT 567	PCR and DNA Fingerprinting		
BIT 568	Genome Mapping		
BIT 569	RNA Purification and Analysis		

BIT 595	Special Topics
BCH 553	Biochemistry of Gene Expression
BCH 701	Macromolecular Structure
BCH 703	Macromolecular Synthesis and Regulation
BCH 705	Molecular Biology Of the Cell
BCH 761	Advanced Molecular Biology Of the Cell
CBS 754	Epidemiology II
CBS 762	Principles of Pharmacology
CBS 795	Special Topics in Comparative Biomedical Sciences
CH 572	Proteomics
GN 735	Functional Genomics
HS 707	Environmental Stress Physiology
MB 751	Immunology
MEA 540	Principles of Physical Oceanography
PHY 503	General Physiology I
PHY 504	General Physiology II
PHY 780	Mammalian Endocrinology
ST 512	Statistical Methods For Researchers II

* Other courses must be approved in conjunction with the academic committee.

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Toxicology (Minor)

Plan Requirements

MS Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
TOX 701	Fundamentals of Toxicology		
TOX 710	Molecular and Biochemical Toxicology		
TOX 715	Environmental Toxicology		
Total Hours		**9**	

PhD Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**13**	
TOX 701	Fundamentals of Toxicology		
TOX 710	Molecular and Biochemical Toxicology		
TOX 715	Environmental Toxicology		
TOX 801	Toxicology Seminar		
Additional TOX Elective approved in conjunction with the academic committee			
Total Hours		**13**	

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Graduate Certificates - College of Sciences

Certificates

- Applied Statistics and Data Management (Certificate) (p. 772)
- Biology for Educators (Certificate) (p. 779)
- Climate Adaptation (Certificate) (p. 739)
- Mathematics (Certificate) (p. 752)
- Statistics Education (Certificate) (p. 772)

Applied Statistics and Data Management (Certificate)

In the Graduate Certificate in Applied Statistics and Data Management, students will learn statistical methods and how to apply them in real world settings and about statistical programming techniques that are required for managing data in a typical workplace environment.

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ST 555	Statistical Programming I		
ST 556	Statistical Programming II		
or ST 558	Data Science for Statisticians		
ST 511	Statistical Methods For Researchers I *		
or ST 513	Statistics for Management and Social Sciences I		
ST 512	Statistical Methods For Researchers II *		
or ST 514	Statistics For Management and Social Sciences II		
Total Hours		**12**	

* The course sequence ST 511 and ST 512 is similar to that of ST 513 and ST 514. The main difference is that ST 511 and ST 512 focus more heavily on analysis of designed experiments, where ST 513 and ST 514 focus more heavily on the analysis of observational data.

- The certificate will be earned by successful completion of four courses listed above with an average GPA of at least 3.0.

Biology for Educators (Certificate)

The Graduate Certificate in Biology for Educators will provide additional training in biological sciences to K-12 teachers and other educators. The certificate will provide recognition to those individuals who complete 12 credit hours of coursework in graduate level biology, with the option to complete up to 18 credit hours for those interested in teaching AP courses or teaching at the community college level (dependent on individual community college credential requirements). All students will choose between four and six courses (3 credits each) in topic areas that align with their own goals, including a capstone course in the science of learning. Course topics will include animal behavior, communicable and non-communicable diseases, toxicology, evolution, genetics and microbiology. Faculty are continuing to develop new courses to increase options.

Applicants must meet at least one of these three requirements:

- have earned a bachelor's degree from an accredited college or university with minimum 3.0 GPA in the last 60 credit hours of undergraduate study
- be a graduate student in good standing in an education-related masters or doctoral program
- have earned a master's degree from an accredited college or university

In addition, applicants will be required to submit a one-page statement describing how this program will benefit their personal or professional development and career goals.

Financial aid support is not typically offered to students seeking certificates. However, we encourage prospective students to pursue the possibility of tuition reimbursement programs through their employer. Additionally, courses taken during the fall and spring terms can be paid for using the NC State payment plan.

Plan Requirements

- Option One: Select 12 credits
- Option Two: Select 18 credits, gives Educators enough graduate-level courses to teach Advanced Placement (AP) classes at the high school level or to teach in community college

Code	Title	Hours	Counts towards
BIO 405	Functional Histology	3	
BIO 424	Endocrinology	3	
MB 411	Medical Microbiology	3	
MB 441	Immunology	3	
MB 451	Microbial Diversity	3	
TOX 401	Principles of Toxicology	4	
TOX 415	Environmental Toxicology and Chemistry	4	

BSC 514	Studying Animal Behavior (Special Topics: Introduction to Animal Behavior)	3
BSC 546	Humans and Disease: Communicable Diseases	3
BIO 592	Topical Problems (Special Topics: Cancer Biology, Progression and Therapeutics)	3
BIO 592	Topical Problems (Special Topics: Model Organisms in Cellular and Molecular Biology)	1-3
BSC 516	Toxics, Human Health, and the Environment	3
BIO 592	Topical Problems (Genetics: Fundamental Concepts and Societal Issues)	3
BIO 592	Topical Problems (Primate Behavior)	3

Climate Adaptation (Certificate)

The Graduate Certificate in Climate Adaptation program at NC State University provides accredited, academic training in the emerging field of climate adaptation. The online, twelve credit program is designed to provide mid-career professionals and entry-level students with technological skills and specialization in climate adaptation. The certificate is a fully accredited credential and a potential path toward the Climate Adaptation degree program. Coursework includes Fundamentals of Climate Change Science, Climate Risk Analysis, Climate Communication and Introduction to Geographic Information Systems.

Admission Requirements

Applicants must meet one of the 3 following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study.
- Have a Master's degree.
- Be a degree student in good standing in a NC State University graduate program.

We recommend that students in a NC State University graduate program may apply after completing two of the courses required for the graduate certificate program with at least B grades. The graduate certificate program Director will manage the admissions process in consultation with the MEAS Director of Graduate Programs.

Provisional Admission

Applicants who do not meet the graduate certificate program requirements for full admission may be admitted provisionally based on the quality of their letters of recommendation and other criteria at the discretion of the Certificate Program Director and MEAS Director of Graduate Programs. Students who are admitted provisionally must maintain a 3.0 GPA in order to obtain full admission into the certificate program.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
MEA 517	Fundamentals of Climate Change Science	3	
MEA 518	Adaptation to Climate Change	3	
MEA 519	Barriers to Climate Change Literacy	3	
GIS 510	Fundamentals of Geospatial Information Science and Technology	3	
Total Hours		**12**	

Mathematics (Certificate)

The Graduate Certificate in Mathematics is a one-year program that focuses on two groups of students. It is designed for students who have some mathematical training but do not have a full bachelor's degree in mathematics. It also targets students who have a bachelor's degree in mathematics but do not feel they are ready for graduate school.

The goal of the certificate is to prepare and motive students through courses and careful mentoring. The program will deepen and broaden students' understanding of mathematics, the mathematics profession, and the mathematical community. Students will learn how the mathematics discipline can solve significant problems for government, industry, other scientists, and ultimately, society at large.

Admissions

Application to the program requires an online application form, three (3) letters of recommendation (two need to be academic), transcripts of all academic work after high school, and a written statement. GREs are highly desirable but not required for admission. Admission will be on a competitive basis.

Requirements

Students take a combination of graduate and undergraduate mathematics courses that are tailored to the individual student. The certificate requires 12 hours of mathematics courses, taken for a grade, and to be taken at NC State. There is no specific list of courses for the certificate.

Of the 12 hours, three (3) hours may be at the 400 level with prior approval of the Director of Graduate Programs. The other nine (9) hours will be at the 500 level or above. Students must take at least two (2) courses per semester to remain in good standing. A grade of C- is required for a course to count toward the certificate. A 3.00 GPA is required to earn the certificate.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses *		**12**	
	One course may me taken at the 400-level with DGP approval		
	A minimum of three courses must be taken at the 500- or 700-level		
Total Hours		**12**	

* Students must maintain an average 3.0 GPA in all MA courses.

Statistics Education (Certificate)

In the Graduate Certificate in Statistics Education, students will learn statistical concepts, methods, and pedagogical techniques for teaching these statistical topics at the college (or high school) level. The emphasis of the program is on the effective use of modern technology for teaching statistics. The courses required for this graduate certificate are listed below.

- Statistical Methods I: ST 511 (or ST 513)
- Statistical Methods II: ST 512 (or ST 514)
- Teaching and Learning of Statistical Thinking: ST 519
- Teaching Statistics with Technology: ST 557

Admissions

The application process is very simple, there are no official prerequisites except for an undergraduate degree. Applicants should demonstrate an appropriate level of mathematical maturity to allow them to succeed in the certificate program. Examples of this would include successful completion of undergraduate coursework or professional work in a quantitative field. Note that the GRE is not required to apply and we only accept students living in North America.

Requirements

The certificate will be earned by successful completion of four courses listed above with an average GPA of at least 3.0.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ST 511	Statistical Methods For Researchers I		
ST 512	Statistical Methods For Researchers II		
ST 519	Teaching and Learning of Statistical Thinking		
ST 557	Using Technology to Teach Statistics		
Total Hours		**12**	

College of Veterinary Medicine

Programs

- Comparative Biomedical Sciences (p. 781)
- Nutrition (p. 176)
- Physiology (p. 188)

Degree Programs

MR

- Nutrition (MR) (p. 178)
- Physiology (MR) (p. 190)

MS

- Comparative Biomedical Sciences (MR): Food Animals Concentration (PSM) (p. 786)
- Comparative Biomedical Sciences (MS) (p. 784)
- Nutrition (MS) (p. 181)
- Physiology (MS) (p. 191)

PhD

- Comparative Biomedical Sciences (PhD): Cell Biology Concentration (p. 791)
- Comparative Biomedical Sciences (PhD): Immunology Concentration (p. 793)
- Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration (p. 796)
- Comparative Biomedical Sciences (PhD): Neurosciences Concentration (p. 798)
- Comparative Biomedical Sciences (PhD): Pathology Concentration (p. 800)
- Comparative Biomedical Sciences (PhD): Pharmacology Concentration (p. 803)
- Comparative Biomedical Sciences (PhD): Population and Global Health (p. 805)
- Nutrition (PhD) (p. 183)

Minors

- Comparative Biomedical Science (Minor) (p. 808)
- Nutrition (Minor) (p. 186)
- Physiology (Minor) (p. 192)

Comparative Biomedical Sciences

Course offerings and research topics currently include, but are not limited to: cell biology, genomics, infectious diseases, developmental

biology, immunology, cardiology, pharmacokinetics, oncology, toxicology, gastroenterology, neuroscience, reproductive physiology, biotechnology, microbiology, aquatic/ wildlife biology, biomedical engineering, endocrinology, molecular biology, pulmonary biology, epidemiology, population medicine, health systems monitoring, transplantation and radiology.

Admission Requirements

All applications are reviewed by the Graduate Studies Committee of the CBS Program, composed of faculty members representing each area of the graduate program and a graduate student representative. Scores from the GRE are not required for admission. Candidates who do not have a DVM degree must have a baccalaureate degree or advanced degree from a college or university recognized as standard by a regional or general accrediting agency. Students with a 3.0 (on a 4.0 scale) undergraduate or DVM curriculum with appropriate course background will be considered for admission.

Doctoral Degree Requirements

Credit hour requirements for the Ph.D. degree are determined by the graduate student's committee with approval of the Director of Graduate Programs and the Graduate School.

Student Financial Support

Research assistantships and fellowships are awarded to qualified candidates on the competitive basis by the College. These are for 12-month periods, and stipends are competitive with those of other programs. These positions are funded by the grants of individual faculty members and the state appropriations to the College and departments.

Other Relevant Information

The program is organized as seven areas of concentration which include: cell biology, immunology, neuroscience, infectious diseases, pathology, pharmacology, and population and global health. These provide extensive interdisciplinary training and maintain a highly effective liaison with graduate programs in other colleges of the university, as well as those of nearby Duke University and the University of North Carolina at Chapel Hill.

Degrees

- Comparative Biomedical Sciences (MS) (p. 784)
- Comparative Biomedical Sciences (MS): Food Animals Concentration (PSM) (p. 786)
- Comparative Biomedical Sciences (PhD) (p. 789)
- Comparative Biomedical Sciences (PhD): Cell Biology Concentration (p. 791)
- Comparative Biomedical Sciences (PhD): Immunology Concentration (p. 793)
- Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration (p. 796)
- Comparative Biomedical Sciences (PhD): Neurosciences Concentration (p. 798)
- Comparative Biomedical Sciences (PhD): Pathology Concentration (p. 800)
- Comparative Biomedical Sciences (PhD): Pharmacology Concentration (p. 803)
- Comparative Biomedical Sciences (PhD): Population and Global Health (p. 805)
- Comparative Biomedical Science (Minor) (p. 808)

Faculty

Full Professors

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Adam Joseph Birkenheuer

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Santosh Kumar Mishra

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Annie Oh

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Kursten Veronica Pierce

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Johanna Rebecca Elfenbein

Comparative Biomedical Sciences (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
Select a specialization		2-19	
Total Hours		**10-27**	

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Comparative Biomedical Sciences (MR): Food Animals Concentration (PSM)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
Select a specialization		2-19	
Total Hours		**10-27**	

Concentration Requirements

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Comparative Biomedical Sciences (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Faculty

Full Professors

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Comparative Biomedical Sciences (PhD): Cell Biology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
GN 701	Molecular Genetics	3	
CBS 770	Cell Biology	3	
CBS 810	Special Topics [1]	3	
Total Hours		**9**	

[1] Other concentration seminars can be substituted

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Comparative Biomedical Sciences (PhD): Immunology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
MB/IMM 751	Immunology	3	
Select one of the following:		3	
CBS 783	Advanced Immunology		
PO/IMM 757	Comparative Immunology		
Select one of the following:		3	
BCH 553	Biochemistry of Gene Expression		
BCH 555	Proteins and Molecular Mechanisms		
BCH 705	Molecular Biology Of the Cell		
BIT 510	Core Technologies in Molecular and Cellular Biology		
CBS 770	Cell Biology		
CBS 816	Advanced Topics In Immunology [1]	8	
Total Hours		**17**	

[1] Other concentration seminars can be substituted

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Comparative Biomedical Sciences (PhD): Infectious Diseases Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
CBS 810	Special Topics (Seminar in Infectious Diseases) [1]	3	
Total Hours		**3**	

[1] Other concentration seminars can be substituted

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Comparative Biomedical Sciences (PhD): Neurosciences Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
CBS/BIO 705	Fundamentals of Neuroscience	3	
CBS/BIO 805	Special Topics in Neuroscience	1	
Total Hours		**4**	

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Comparative Biomedical Sciences (PhD): Pathology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
CBS 795	Special Topics in Comparative Biomedical Sciences (General Pathology)	1-6	
CBS 810	Special Topics (Seminar in Pathology) [1]	3	
Total Hours		**4-9**	

[1] Other concentration seminars can be substituted

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Comparative Biomedical Sciences (PhD): Pharmacology Concentration

Degree Requirements

Code	Title	Hours	Counts towards
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CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
BCH 553	Biochemistry of Gene Expression	3	
TOX 701	Fundamentals of Toxicology	3	
TOX 710	Molecular and Biochemical Toxicology	3	
CBS 762	Principles of Pharmacology	3	
CBS 787	Pharmacokinetics	3	
CBS 810	Special Topics (Seminar in Pharmacology)	3	
Total Hours		**18**	

[1] Other concentration seminars can be substituted

Faculty

Full Professors

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Comparative Biomedical Sciences (PhD): Population and Global Health

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses			
CBS 565	Fundamentals of Biomedical Sciences	3	
ST 511	Statistical Methods For Researchers I	3	
or ST 517	Applied Statistical Methods I		
CBS 662	Professional Conduct in Biomedical Research	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
CBS 800	CBS Seminar	1	
Total Hours		**10**	

Concentration Requirements

Code	Title	Hours	Counts towards
Core Courses		**10**	
See "Core Courses" listed above			
Concentration Courses		**12**	
CBS 650	Population Medicine Forum (Seminar in Pop Med & Vet Public Health) [1]		
or CBS 595	Special Topics		
CBS 650	Population Medicine Forum (Seminar in Pop Med & Vet Public Health)		
CBS 650	Population Medicine Forum (Seminar in Pop Med & Vet Public Health)		
CBS 775	Designing population-based research		
Elective Courses		**6**	
See "Elective Courses" listed below			
Total Hours		**28**	

[1] Other concentration seminars can be substituted

Elective Courses

Code	Title	Hours	Counts towards
Select at least three of the following courses:			
CBS 580	Epidemiology I	3	
CBS 586	One Health: From Philosophy to Practice	2	
CBS 649	Issues in Preventive Medicine and Public Health	1	
CBS 713	Zoonoses and Public Health	3	
CBS 754	Epidemiology II	3	

CBS 776	Infectious Disease Dynamics	
BMA 560	Population Ecology	3
BMA 567	Modeling of Biological Systems	4
GN 703	Population and Quantitative Genetics	3
SOC 755	Global Institutions and Markets	3
SOC 762	Sociology of Food Systems	3
SOC 761	Contemporary Debates in Food & Environment	3
PA 511	Public Policy Analysis	3
PA 715	Quantitative Policy Analysis	3
BIT 477	Metagenomics	2
BIT 815	Advanced Special Topics	1-6
ST 505	Applied Nonparametric Statistics	3
ST 506	Sampling Animal Populations	3
ST 512	Statistical Methods For Researchers II	3
ST 520	Statistical Principles of Clinical Trials	3
ST 531	Experimental Design	3
ST 533	Applied Spatial Statistics	3
ST 535	Statistical Methods for Quality and Productivity Improvement	3
ST 537	Applied Multivariate and Longitudinal Data Analysis	3
ST 540	Applied Bayesian Analysis	3
ST 544	Applied Categorical Data Analysis	3
ST 590	Special Topics (Intro to Bioinformatics)	1-6
ST 590	Special Topics (Bioinformatics II)	1-6
ST 745	Analysis of Survival Data	3

Faculty

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Johanna Rebecca Elfenbein

Comparative Biomedical Science (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Institute for Advanced Analytics

Programs

- Analytics (p. 810)

Degree Programs

Master of Science (MS)

- Analytics (MS) (p. 811)

Analytics

The Master of Science in Analytics (MSA) is uniquely designed to equip students for the task of deriving and effectively communicating actionable insights from a vast quantity and variety of data. It is an intensive 10-month degree with a strong practical orientation focused on the tools and methods used by data scientists. It is a fully integrated course of study taught exclusively to MSA students and designed to produce well-rounded professionals. Student teams tackle genuine problems with data provided by industry and government sponsors.

Admission Requirements

Admission to the MSA program is highly competitive. The best-qualified applicants will be accepted up to the limited number of seats available for students each year. The Admissions Committee evaluates candidates on criteria such as:

- overall academic record and grade point average;
- academic performance in analytical/quantitative subjects;

- relevant employment experience and potential to succeed in the profession; and
- leadership potential, integrity, and other personal character traits.

The Institute welcomes applications from highly motivated individuals of exceptional talent regardless of undergraduate major. Applicants without prior coursework in statistics and/or experience with computer programming would need to complete a set of prerequisite courses before qualifying as a candidate for admission.

Master's Degree Requirements

Students complete 30 credit hours of defined coursework in a period of ten months beginning in Summer Session II and ending the following Spring semester. The integrated curriculum is designed to provide a focused education in the software tools, methods and applications of data analytics.

Other Relevant Information

Students must begin the degree program in the first semester (Summer Session II) and complete all 30 credit hours of the curriculum. The program is designed for full-time students only. Applications for admission are reviewed between September and April.

2022-2023 Program Schedule

Summer II 2022: AA 500 and AA 501

- Start date: June 23, 2022
- Census date: June 29, 2022
- Withdrawal date: June 27, 2022 (no refund on or after July 14, 2022)
- End date: July 29, 2022
- Last day of finals: July 29, 2022
- Communications Training (required): August 1 - August 12, 2022

Fall 2021: AA 502 and AA 504

- Start date: August 17, 2022
- Census date: September 2, 2022
- Withdrawal date: August 17 (no refund after October 11, 2022)
- End date: December 2, 2022
- Last day of finals: December 2, 2022
- Practicum project work, midpoint presentations, career and professional development activities (required): December 5 - December 16, 2022

Spring 2022: AA 503 and AA 505

- Start date: January 9, 2023
- Census date: January 23, 2023
- Withdrawal date: January 9, 2023 (no refund on or after March 1, 2023)
- End date: April 28, 2023
- Last day of finals: April 28, 2023
- Spring Commencement: May 6, 2023

Degrees

- Analytics (MS) (p. 811)

Full Professors

Christopher G. Healey

Michael A. Rappa

Practice/Research/Teaching Professors

Susan Jeanne Simmons

Aric David LaBarr

Christopher West

Andrea Villanes Arellano

Sarah Egan Warren

Analytics (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**30**	
AA 500	Analytics Tools and Techniques		
AA 501	Analytics Foundations		
AA 502	Analytics Methods and Applications I		
AA 504	Analytics Practicum I		
AA 503	Analytics Methods and Applications II		
AA 505	Analytics Practicum II		
Total Hours		**30**	

Full Professors

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Sarah Egan Warren

Poole College of Management

Programs

- Accounting (p. 812)
- Business Administration (p. 816)
- Economics (p. 826)
- Management (p. 836)

Degree Programs

Master's (MR)

- Accounting (MR) (p. 813)
- Business Administration (MR) (p. 818)
- Economics (MR) (p. 828)
- Management (MR): Marketing Analytics Concentration (p. 837)
- Management (MR): Risk and Analytics Concentration (p. 837)

Minors

- Business Administration (Minor) (p. 821)
- Economics (Minor) (p. 834)

Certificates

- Business Analytics (Certificate) (p. 822)
- Business Leadership (Certificate) (p. 823)
- Finance (Certificate) (p. 824)
- Marketing (Certificate) (p. 824)
- Operations and Supply Chain Management (Certificate) (p. 825)
- Tax Analytics and Technology (Certificate) (p. 815)
- Technology Entrepreneurship and Commercialization (Certificate) (p. 826)

Accounting

The Jenkins Master of Accounting (MAC) program provides exceptional education and real-world experience that equip students to take their careers to the next level. Whether pursued on campus and in-person or taken entirely online, the program’s curriculum is designed to provide students with a broad understanding of accounting and business practices, as well as a rigorous technical accounting education. Students have the choice of two tracks (public accounting or business and industry) to meets the needs of their career goals in the accounting profession. They can choose to complement these core courses with specializations in Enterprise Risk Management, Information Technology, or Tax Strategy.

The curriculum is focused on both preparing you for the CPA exam and developing real-world skills, and learning doesn’t stop in the classroom. MAC students can study abroad, lead financial literacy courses on campus or in the community, work with real companies in practicum exercises and take advantage of innovative learning opportunities.

Admission Requirements

Admission to the MAC program is competitive. The best-qualified applicants will be accepted up to the number of spaces available for new students. The Admissions Committee evaluates candidates on three criteria:

- undergraduate academic record and grade point average;
- GMAT score*;
- "Engagement & Leadership" -- relevant activities and/or work experience, student athletics, volunteer work/community involvement, study abroad, in-person MAC interview, overall presence, leadership experience and integrity.

[*The Admissions Committee requires all applicants who score below 530 on their first attempt to retake the GMAT exam prior to the application deadline.]

Individuals with a Bachelor's degree in any major may apply to the program; however, any applicant without a Bachelor's degree in Accounting must complete a series of undergraduate Accounting prerequisites before qualifying as a MAC degree candidate. These prerequisites are available to take online. More complete information can be found on the MAC website (https://poole.ncsu.edu/mac/admissions/).

Fellowships (On-campus)

As a part of the admissions process, applicants may be considered for Jenkins Graduate School's merit-based MAC fellowships. Students may qualify for a firm-sponsored or an academic fellowship. A fellowship may provide financial support for educational expenses and also may include an offer of employment upon graduation (firm-sponsored option). All required application materials must be submitted by the February 1st application deadline to be considered for a fellowship.

Scholarships

MAC scholarships are merit-based and are made possible through a partnership between sponsoring CPA firms, the NC State Graduate School, alumni and the Poole College of Management’s Department of Accounting. All students who submit an application no later than February 1st are considered for a scholarship award. Recipients of MAC scholarships are selected based on their scholarship, leadership, service, experience, presence and integrity. Scholarships range from $2,000 to $19,000.

Master's Degree Requirements

Students that choose the Public Accounting Track (p. 813), complete an 11-course sequence that includes eight graduate-level Accounting courses and three elective courses (31 total credit hours). The Business and Industry Track (p. 814) includes six graduate-level accounting courses and four electives (30 total credit hours). The curriculum is designed to provide a broad-based professional education. Students have the opportunity to focus their education by choosing one of our three optional specializations: enterprise risk management, information technology or tax strategy. These specializations provide an additional depth of knowledge that can give students a leg up as they enter their chosen profession.

Other Relevant Information

On-Campus MAC

We accept applications starting in the fall but encourage interested applicants to apply early to be eligible for our many scholarship and fellowship opportunities.

- **December 1**: Early admission deadline
- **February 1**: Deadline for MAC scholarship and fellowship consideration
- **March 1**: Final admission deadline

Online MAC

- **October 1**: Limited number of spots available for those interested in a January program start
- **December 1**: Early admission deadline
- **February 1**: Second admission deadline
- **March 1**: Final admission deadline

Degrees

- Accounting (MR) (p. 813)
- Tax Analytics and Technology (Certificate) (p. 815)

Faculty

Full Professors

Mark S. Beasley

Marianne Bradford

Bruce C. Branson

Katherine Ann Krawczyk

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James Scalise

Scott Showalter

Accounting (MR)

Degree Requirements

The Master of Accounting program offers the following tracks:

- Public Accounting (p. 813)
  - Tax Strategy
  - Business Reporting and Analysis
  - Information Technology
  - Enterprise Risk Management
- Business and Industry (p. 814)
- Transition to Business and Industry (p. 815) (*admitting for Fall 2022*)

Degrees earned will be distributed as: "Master of Accounting" without track specifications.

Code	Title	Hours	Counts towards
Required Core Courses		**9**	
ACC 519	Applied Financial Management		
ACC 530	Advanced Income Tax		
ACC 540	IT Risks and Controls		
Track Courses		**9-22**	
Select the corresponding coursework based on the track selection listed below			
Elective Courses			
Elective courses will be approved in conjunction with the academic committee to meet total required credit hours			
Total Hours		**30-39**	

Public Accounting Track

Code	Title	Hours	Counts towards
Required Track Courses		**13**	
ACC 508	Advanced Commercial Law		
ACC 510	Advanced Financial Accounting		
ACC 533	Accounting and Tax Research		
ACC 550	Advanced Auditing		
ACC 600	Managerial and Career Effectiveness		
Focus Area Courses		**9**	
Select courses within one of the following focus areas:			
Tax Strategy			
BUS 590	Special Topics In Business Management (Corporate Tax Strategy)		
MBA 525	Taxes and Business Strategy		

ACC 564	Project Management and Process Documentation in Tax
ACC 565	Visual Analytics in Tax
Business Reporting & Analysis	
ACC 520	Advanced Management Accounting
ACC 588	Special Topics in Accounting
BUS 590	Special Topics In Business Management (Strategic Risk Analysis Using Excel)
BUS 590	Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)
BUS 590	Special Topics In Business Management (Creating Management Dashboards Using Tableau)
Information Technology	
MBA 511	Data Security and Privacy
MBA 515	Enterprise Resource Planning Systems
ACC 588	Special Topics in Accounting
BUS 590	Special Topics In Business Management (Strategic Risk Analysis Using Excel)
BUS 590	Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)
BUS 590	Special Topics In Business Management (Creating Management Dashboards Using Tableau)
Enterprise Risk Management	
MBA 518	Enterprise Risk Management
MBA 519	Enterprise Risk Management Practicum
BUS 590	Special Topics In Business Management (Strategic Risk Analysis Using Excel)
BUS 590	Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)
BUS 590	Special Topics In Business Management (Creating Management Dashboards Using Tableau)
Total Public Accounting Track & Focus Area Hours	**22**

Business and Industry Track

Code	Title	Hours	Counts towards
Required Track Courses		**9**	
ACC 520	Advanced Management Accounting		
ACC 588	Special Topics in Accounting (Data Analytics in Accounting)		
MBA 518	Enterprise Risk Management		
Total Hours		**9**	

Transition to Business and Industry Track

Code	Title	Hours	Counts towards
Accounting Prerequisites		**9**	
ACC 310 & ACC 311	Intermediate Financial Accounting I and Intermediate Financial Accounting II		
ACC 220/340	Introduction to Managerial Accounting		
ACC 330 & MIE 305	An Introduction To Income Taxation and Legal and Regulatory Environment		
Required Track Courses		**9**	
ACC 520	Advanced Management Accounting		
ACC 588	Special Topics in Accounting (Data Analytics in Accounting)		
MBA 518	Enterprise Risk Management		
Total Hours		**18**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

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Tax Analytics and Technology (Certificate)

The Graduate Certificate in Tax Analytics and Technology is currently a two to three year online program that targets for enrollment MAC and MBA graduate students at NC State, graduate students at other universities and working professionals in the Research Triangle, national and global community. They will learn knowledge and skills to extract, manipulate, analyze, and summarize tax data to solve tax problems, identify opportunities for tax savings, and to effectively communicate actionable tax and business strategies to organizations.

Admissions Requirements

Graduate students at NC State must be in good standing. Students not enrolled at NC State must have completed a baccalaureate degree and have either taken some introductory/intermediate accounting and tax courses or have work experience in these areas. All students must submit an application to the certificate program which will be reviewed and evaluated by the coordinator. A minimum GPA of 3.0 (in undergraduate and/or prior graduate work) is required for admission to the program.

Program Requirements

The certificate program requires students to complete twelve (12) one-credit hour online courses with an overall 3.0 GPA in all courses. No transfer credits will be accepted in the program and it must be completed within four years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework from the following:			
ACC 560	Tools for Tax Analytics		

ACC 561	Database Management in Tax	
ACC 562	Forecasting Effective Tax Rates and Scenario Analysis - Introduction	
ACC 563	Forecasting Effective Tax Rates and Scenario Analysis - Advanced Application	
ACC 564	Project Management and Process Documentation in Tax	
ACC 565	Visual Analytics in Tax	
ACC 566	Database Management Applications in Tax	
ACC 569	Advanced Visual Analytics in Tax	
ACC 570	Data Security and Warehousing in Tax	
Elective Courses		**3**
Select three hours of coursework from the following:		
BUS 590	Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)	
BUS 590	Special Topics In Business Management (Creating Management Dashboards Using Tableau)	
MBA 506	Data-Driven Managerial Decisions 1	
MBA 507	Data-Driven Managerial Decisions 2	
MBA 511	Data Security and Privacy	
MBA 545	Decision Making under Uncertainty	
MBA 551	Predictive Analytics for Business and Big Data	
Total Hours		**12**

Business Administration

The Master of Business Administration (MBA) program develops business leaders for tomorrow's global markets and technologies. The Jenkins MBA program provides students with the requisite foundation in general business management, while also allowing time to focus on an area of particular interest. In pairing academic excellence with real-world experience, Jenkins MBA students are ready to meet global challenges head-on with practical, technology-driven solutions. Students may choose to pursue an MBA through the Full-time program on NC State's main campus; the Professional Evening program with locations on NC State's main campus as well as a RTP location; or the Online program.

Admission Requirements

In addition to the basic Graduate School admission requirements, full-time MBA applicants must submit recent GMAT/GRE scores, unless approved for a test waiver. Admission decisions for both full-time and working professional applicants are based on academic performance and potential, GMAT or GRE scores (when applicable), essays, recommendations, relevant work experience and an interview. Students must have previous coursework in statistics before entering the program.

Master of Business Administration

The MBA program requires every student to complete the core curriculum that includes coursework in accounting, economics, finance, marketing, operations / supply chain, organizational behavior, statistics and strategy, as well as communications, ethics and critical thinking and writing. Full-time students must complete a minimum of 54 credit hours; Professional Evening and Online students must complete a minimum of 40 credit hours.

Additional Requirements

Full-time

In addition to the core curriculum, students must complete a minimum of 12 elective hours within a concentration; an advanced analytics course; and a practicum. Students then have the opportunity to choose from a variety of elective courses to meet the 54 credit hour minimum.

Professional Evening and Online

In addition to the core curriculum, students must complete an advanced analytics course and a practicum. Students then have the opportunity to choose from a variety of elective courses to meet the 40 credit hour minimum.

Other Relevant Information

Fall 2021 Course Schedule

Full Semester

- Start: 8/16/2021
- End: 11/29/2021

1st 5 weeks: MBA 501, MBA 506 (FT), MBA 507 (Pro)

- Start: 8/16/2021
- End: 9/14/2021 – 9/20/2021

1st 8 weeks: MBA 510-631; MBA 590-001; MBA 8W1 Electives

- Start: 8/16/2021
- End: 10/7/2021

1st 10 weeks: MBA 505, MBA 560

- Start: 8/16/2021
- End: 10/14/2021 – 10/25/2021

Last 10 Weeks: MBA 520, MBA 540

- Start: 9/16/2021 – 9/27/2021
- End: 11/29/2021

2nd 8 Weeks: MBA 510-001,-632; MBA 8W2 Electives

- Start: 10/8/2021
- End: 11/29/2021

Last 5 Weeks: MBA 502, MBA 506 (Pro), MBA 507 (FT)

- Start: 10/21/2021 – 10/27/2021
- End: 11/29/2021

Spring 2022 Course Schedule

FULL SEMESTER

- Start: 1/10/2022
- End: 4/25/2022

1ST 5 WEEKS: MBA 501, MBA 507

- Start: 1/10/2022
- End: 2/12/2022 -- 2/19-2022

1ST 8 WEEKS: MBA 510-631; MBA 512-001; MBA 530-001; MBA 8W1 ELECTIVES

- Start: 1/10/2022
- End: 3/2/2022

1ST 10 WEEKS: MBA 505, MBA 560

- Start: 1/10/2022
- End: 3/19/2022 -- 3/21/2022

LAST 10 WEEKS: MBA 520, MBA 540

- Start: 2/13/2022 -- 2/20/2022
- End: 4/25/2022

2ND 8 WEEKS: MBA 510-001,-632; MBA 512-001; MBA 8W2 ELECTIVES

- Start: 3/2/2022
- End: 4/25/2022

LAST 5 WEEKS: MBA 502, MBA 506

- Start: 3/20-2022 -- 3/23/2022
- End: 4/25/2022

Degrees

- Business Administration (MR) (p. 818)
- Business Administration (Minor) (p. 821)
- Business Analytics (Certificate) (p. 822)
- Business Leadership (Certificate) (p. 823)
- Finance (Certificate) (p. 824)
- Marketing (Certificate) (p. 824)
- Operations and Supply Chain Management (Certificate) (p. 825)
- Technology Entrepreneurship and Commercialization (Certificate) (p. 826)

Faculty

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Sarah Khan

Leigh Shamblin

Thomas Joseph Zagenczyk

Business Administration (MR)

Full-Time Degree Requirements

Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

Code	Title	Hours	Counts towards
Core Courses		**22**	
	See "Core Courses" listed below		
Concentration Area Courses [1]		**12**	
	"Concentration Area Courses" are approved in conjunction with the academic committee		
Analytics / Quantitative Course [2]		**3**	
	"Analytics / Quantitative Course" is approved in conjunction with the academic committee		
Practicum Course [3]		**3**	
	"Practicum Course" is approved in conjunction with the academic committee		
Elective Courses [4]		**14**	
	"Elective Courses" are approved in conjunction with the academic committee		
Total Hours		**54**	

1. "Concentration Area Courses" must be a minimum of 12 credit hours in entrepreneurship, finance, innovation management, marketing, or operations.
2. "Analytics / Quantitative Course" is a minimum of one course that builds upon the core statistics course. Offerings include electives in applied statistics, finance, information technology, marketing, and operations.
3. "Practicum Course" must be a minimum of one course semester-long course where students serve as a consulting team for an actual organization. Offerings include applications in analytics, consulting, entrepreneurship, finance, marketing, product innovation, operations and supply chain, and risk management.
4. "Elective Courses" may include any graduate course in the Poole College of Management; courses outside the College must be approved by the academic director of the NC State MBA.

Core Courses

All courses in the following categories are required by all MBA students:

Markets and Finance

Code	Title	Hours	Counts towards
MBA 501	Financial Accounting for Decision Makers	1	
MBA 502	Managerial Accounting for Decision Makers	1	
MBA 505	Essential Economics for Managers	2	
MBA 520	Financial Management of Corporations	2	

Analyzing the Value Chain

Code	Title	Hours	Counts towards
MBA 506	Data-Driven Managerial Decisions 1	1	
MBA 507	Data-Driven Managerial Decisions 2	1	
MBA 540	Principles of Operations and Supply Chain Management	2	
MBA 560	Marketing Management and Strategy	2	

Managing the Organization

Code	Title	Hours	Counts towards
MBA 510	Critical Thinking for Managers	1	
MBA 512	Ethical Thinking for Managers	1	
MBA 530	Leading People	3	
MBA 580	Creating Value in Organizations	3	
MBA 590	Special Topics In Business Management		
MBA 610	Special Topics in Business Administration		

Part-Time Degree Requirements

Degrees earned will be distributed as: "Master of Business Administration" without focus area specifications.

Code	Title	Hours	Counts towards
Core Courses		**20**	
See "Core Courses" listed below			
Analytics / Quantitative Course [1]		**3**	
"Analytics / Quantitative Course" is approved in conjunction with the academic committee			
Practicum Course [2]		**3**	
"Practicum Course" is approved in conjunction with the academic committee			
Elective Courses [3]		**14**	
"Elective Courses" are approved in conjunction with the academic committee			
Total Hours		**40**	

Core Courses

All courses in the following categories are required by all MBA students:

Markets and Finance

Code	Title	Hours	Counts towards
MBA 501	Financial Accounting for Decision Makers	1	
MBA 502	Managerial Accounting for Decision Makers	1	
MBA 505	Essential Economics for Managers	2	
MBA 520	Financial Management of Corporations	2	

Analyzing the Value Chain

Code	Title	Hours	Counts towards
MBA 506	Data-Driven Managerial Decisions 1	1	
MBA 507	Data-Driven Managerial Decisions 2	1	
MBA 540	Principles of Operations and Supply Chain Management	2	
MBA 560	Marketing Management and Strategy	2	

Managing the Organization

Code	Title	Hours	Counts towards
MBA 510	Critical Thinking for Managers	1	
MBA 512	Ethical Thinking for Managers	1	
MBA 531 & MBA 532	Leading People 1 and Leading People 2	3	

MBA 580	Creating Value in Organizations	3

1 "Analytics / Quantitative Course" must be at least one course that builds upon the core statistics course. Offerings include electives in: applied statistics, finance, information technology, marketing, and operations.

2 "Practicum Course" is a semester-long course where students serve as a consulting team for an actual organization. Offerings include: applications in analytics, consulting, entrepreneurship, finance, marketing, product innovation, operations and supply chain, and risk management.

3 "Elective Courses" may include any graduate course in the Poole College of Management; courses outside the College must be approved by the academic director of the NC State MBA.

Faculty

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Sarah Khan

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Thomas Joseph Zagenczyk

Business Administration (Minor)

Plan Requirements

Students enrolled in Master's and doctoral programs can complete the minor by taking courses that meet requirements within the MBA degree.

Master's Minor

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select at least three Graduate-level MBA courses approved in conjunction with the academic committee			
Total Hours		**9**	

PhD Minor

Code	Title	Hours	Counts towards
Required Courses		**15**	
Select at least five Graduate-level MBA courses approved in conjunction with the academic committee [1]			
Total Hours		**15**	

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Business Analytics (Certificate)

The Graduate Certificate in Business Analytics helps to develop management professionals who are skilled in big data analysis and decision-making. It provides management professionals with advanced skills and techniques to address both specific and industry-wide business problems.

Plan Requirements

Pre-Requisites

Students should have taken MBA 506 Data Driven Managerial Decisions 1(1 hr) and MBA 507 Data Driven Managerial Decisions 2 (1 hr) in order to successfully complete this certificate.

Code	Title	Hours	Counts towards
Required Courses		**6**	
MBA 551	Predictive Analytics for Business and Big Data		
MBA 552	Data Engineering, Management and Warehousing		
Required Practicum Course		**3**	
Students need to take either OPTION A or one of the courses from OPTION B that are picked in conjunction with the academic advisor.			
Option A			
MBA 559	Business Analytics Practicum		
Option B			
Select one of the courses listed below in conjunction with the academic advisor			
MBA 519	Enterprise Risk Management Practicum		
MBA 524	Equity Valuation		
MBA 549	Supply Chain Management Practicum		
MBA 589	Jenkins Consulting Practicum		
Elective Courses		**3**	
Select one of the following courses:			
ECG 561	Applied Econometrics I		
ECG 562	Applied Econometrics II		
MBA 545	Decision Making under Uncertainty		
MBA 548	Analytical Supply Chain Management		
MBA 565	Marketing Analytics		
MBA 566	Digital Marketing		
MBA 590	Special Topics In Business Management (Innovation and the IoT Marketplace)		
Total Hours		**12**	

[1] Students can select one of the following practicum course options, provided the project they complete in the course has an analytic focus. Students will need approval from the certificate director before enrolling in one of these courses for analytic certificate credit.

Faculty

Full Professors

Jon Bohlmann

Sebastian Heese

Richard Warr

Associate Professors

Denis Pelletier

Bill Rand

Jeffrey Stonebraker

Assistant Professors

Sherry Fowler

Donnie Hale

Rishika Rishika

Business Leadership (Certificate)

This program is designed to help you coach team members, make smart decisions, create a leadership style that's ideal for you, and develop healthy organizational relationships that nurture and inspire employees. Students focus on seeking embracing leadership challenges as they unfold, making sense of leadership experiences, and thriving in a dynamic business culture while leading with an ethical compass.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**4**	
MBA 531 & MBA 532	Leading People 1 and Leading People 2		
or MBA 530	Leading People		
MBA 539	Jenkins Leadership Challenge		
Elective Courses		**8**	
Select at least eight hours of coursework listed under "Elective Courses" below			
Total Hours		**12**	

Elective Courses

Code	Title	Hours	Counts towards
Select eight hours of coursework from the list below:			
MBA 533	Negotiation and Conflict Management		
MBA 534	Core Concepts of Human Capital Management		
MBA 535	Leading Teams		
MBA 538	Women as Leaders		
MBA 564	Business Relationship Management		
Additional Special Topics Courses			
MBA 590	Special Topics In Business Management (Accelerate Your Career)		
MBA 590	Special Topics In Business Management (AI and Ethics)		
MBA 590	Special Topics In Business Management (Business Ethics)		
MBA 590	Special Topics In Business Management (Business Relationship Management)		
MBA 590	Special Topics In Business Management (Effective Diversity Management)		
MBA 590	Special Topics In Business Management (Effective Presentations to Boards & Executives)		
MBA 590	Special Topics In Business Management (Emotional Intelligence)		
MBA 590	Special Topics In Business Management (Executing a Strategy from a Leadership Prospective)		
MBA 590	Special Topics In Business Management (Improving Performance Through Feedback and Appraisal Systems)		
MBA 590	Special Topics In Business Management (Influencing Others)		
MBA 590	Special Topics In Business Management (The Art of Creating Organizational Culture)		
MBA 590	Special Topics In Business Management (The Art and Science of Negotiation)		

MBA 590	Special Topics In Business Management (The Art and Science of Negotiation in France (study abroad))
MBA 590	Special Topics In Business Management (Toxic and Destructive Leadership)

Faculty

Full Professors

Brad Kirkman

Roger Mayer

Associate Professors

Paul Mulvey

Assistant Professor

Patrick Flynn

Practice/Research/Teaching Professors

Beth Ritter

Leigh Shamblin

Finance (Certificate)

Through theory and applied learning, students come to understand the relationship between capital providers (investing households), capital markets (stocks and bonds), and capital users (firms). Students use real-world tools, such as stock price databases and spreadsheet analysis, to apply theory to practice. This flexible option is ideal for professionals who want to gain a foundational understanding of financial management.

Admissions requirements

Graduate certificate programs are open to NC State MBA students and Master of Management of Marketing Analytics students or to others who are not currently enrolled at NC State with a bachelor's degree from an accredited college or university. The TEC certificate is available for all applicants, including other graduate students at NC State University.

- Four year bachelor's degree (or US degree equivalent) from a regionally accredited college or university.
- Maintained a minimum GPA of 3.0 across all certificate-counting classes in undergraduate and graduate work (some exceptions are available for those with graduate studies).
- Two years of full-time, post-baccalaureate professional employment is required for applicants to certificate programs.
- Standardized test scores (GMAT, GRE) are not required to apply to a graduate management certificate program.

International applicants who are not in a graduate program at NC State must take the TOEFL or IELTS unless they qualify for a waiver.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**3**	
MBA 501	Financial Accounting for Decision Makers		
MBA 520	Financial Management of Corporations		
Elective Courses		**9**	
Select nine credit hours of coursework from the following:			
MBA 521	Advanced Corporate Finance		
MBA 522	Financial Modeling		
MBA 523	Investment Theory and Practice		
MBA 524	Equity Valuation		
MBA 525	Taxes and Business Strategy		
MBA 526	International Finance		
MBA 590	Special Topics In Business Management (Private Equity Venturing)		
Total Hours		**12**	

Marketing (Certificate)

The Marketing Certificate is an innovative option for professionals who want to become skilled in a field that significantly impacts every other industry. Students focus on seeking, identifying and creating business opportunities, developing products/services, and building/maintaining customer relationships while discovering the skills and tools needed to succeed in today's marketing climate.

Admission requirements

For admission requirements, please visit the admissions website (https://mba.ncsu.edu/academics/certificate-programs/admissions-2/). Please note that current graduate students at NC State may not dual enroll into this certificate.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**5**	
MBA 560	Marketing Management and Strategy		
MBA 561	Consumer Behavior		
Marketing Elective		**1**	
Select a marketing elective approved in conjunction with the academic committee			
Research Elective		**3**	
Select one of the following:			
MBA 562	Research Methods In Marketing		
MBA 565	Marketing Analytics		
MBA 566	Digital Marketing		
Additional Elective		**3**	
Select one of the following:			
MBA 562	Research Methods In Marketing [1]		
MBA 563	Product and Brand Management		
MBA 564	Business Relationship Management		
MBA 565	Marketing Analytics		
MBA 566	Digital Marketing		
Total Hours		**12**	

[1] If not taken as the research-oriented course

Operations and Supply Chain Management (Certificate)

The Operations and Supply Chain Management Certification program provides students with in-depth knowledge of the entire supply chain process, from raw materials to finished products. With an emphasis on information and supply flow, students develop the skills needed to write comprehensive management reports, manage teams of workers, and make persuasive management presentations.

Admission requirements

- Four year bachelor's degree (or US degree equivalent) from a regionally accredited college or university.
- Maintained a minimum GPA of 3.0 across all certificate-counting classes in undergraduate and graduate work (some exceptions are available for those with graduate studies).
- Two years of full-time, post-baccalaureate professional employment is required for applicants to certificate programs.
- Standardized test scores (GMAT, GRE) are not required to apply to a graduate management certificate program.

International applicants who are not in a graduate program at NC State must take the TOEFL or IELTS unless they qualify for a waiver.

Please note that current graduate students at NC State may not dual enroll into this certificate.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Prerequisites			
MBA 506	Data-Driven Managerial Decisions 1		
MBA 507	Data-Driven Managerial Decisions 2		
Required Courses		**2**	
MBA 540	Principles of Operations and Supply Chain Management		
Elective Courses		**10**	
Select 10 hours of courses from the following:			
MBA 541	Supply Management		
MBA 542	Supply Chain Logistics		

MBA 543	Planning and Control Systems	
MBA 545	Decision Making under Uncertainty	
MBA 548	Analytical Supply Chain Management	
MBA 549	Supply Chain Management Practicum	
MBA 590	Special Topics In Business Management (Healthcare Supply Chain Analytics)	
MBA 590	Special Topics In Business Management (Operations Analysis)	
MBA 590	Special Topics In Business Management (Strategic Operations)	
MBA 590	Special Topics In Business Management (Operations Models & Applications)	
MBA 590	Special Topics In Business Management (Strategic Supply Chain Management)	
MBA 590	Special Topics In Business Management (Managing Operations)	
Total Hours		**12**

Technology Entrepreneurship and Commercialization (Certificate)

The Technology Entrepreneurship and Commercialization certificate program provides students with a proven approach to evaluating technologies and bringing technology innovations to market. Students who complete the TEC certificate are equipped to evaluate technologies, create and develop product ideas, and construct business proposals.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
MBA/MSE 576	Technology Entrepreneurship and Commercialization I		
MBA/MSE 577	Technology Entrepreneurship and Commercialization II		
Elective Courses		**6**	
Select two of the following:			
MBA 555	Product Design and Development		
MBA 572	Venture Opportunity Analytics		
MBA 578	Venture Launch		
MBA 579	Entrepreneurship Clinic Practicum		
Total Hours		**12**	

Economics

The graduate program in economics is a joint program of the Department of Agricultural and Resource Economics in the College of Agriculture and Life Sciences and the Department of Economics in the Poole College of Management. Emphasis is placed on economic theory and quantitative economic analysis and their application to economic problems. Master's students can choose between the terminal master's track and the PhD-prep track. In both tracks, they may further tailor their experience by choosing to concentrate in one or multiple of the four fields: financial economics; international economics; natural resource and environmental economics and applied econometrics. Students can also choose between engaging in a research project culminating in a thesis (the Master of Science in economics degree) and simply pursuing a coursework only option (the Master of Economics degree). The major fields of specialization for doctoral students are: agricultural economics, development and labor economics, econometrics, environmental/resource economics, international economics, macro-monetary economics and microeconomic theory and industrial organization.

Admission Requirements

Minimum background for admission for Master's study includes principles of economics, calculus I and calculus II, and one semester of statistics at the 300-level (econometrics courses included). For doctoral study, prerequisites are intermediate microeconomics, intermediate macroeconomics, calculus I-III, linear algebra, and a course in mathematical statistics. GRE scores are required for doctoral applicants only.

Master's Degree Requirements

Both the Master of Science in economics and the Master of Economics degrees require core courses in microeconomics, macroeconomics and econometrics. Each degree also carries additional elective requirements. The M.S. degree requires a thesis. Both degrees offer two tracks: a terminal master's track and a PhD-prep track. Both Master's degrees require a total of 30 credit hours. Accelerated Bachelor's/Master's degree programs are available for non-thesis options.

Doctoral Degree Requirements

The Ph.D. program requires a minimum of 72 hours and at least six semesters of work beyond the Bachelor's degree. Students must pass written comprehensive examinations in microeconomics and macroeconomics. Course requirements include two semesters of econometrics and six field courses.

Student Financial Support

Fellowships, research and teaching assistantships are available and are awarded competitively on a merit basis. These fellowships and assistantships go to Ph.D. students only; there is no financial support for Master's students. Prospective doctoral students who wish to be considered for fellowships and assistantships should apply for fall admission by January 1.

Other Relevant Information

Graduate students on financial support are provided office space or study carrels. Other students may be assigned study carrels if available. All students have access to the economics graduate student computer lab.

Degrees

- Economics (MR) (p. 828)
- Economics (MS) (p. 830)
- Economics (PhD) (p. 833)
- Economics (Minor) (p. 834)

Faculty

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Thayer Stephen Morrill

Luca David Opromolla

Nicholas E. Piggott

Roderick M. Rejesus

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Michael L. Walden

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Junjie Wu

Kelly D. Zering

Xiaoyong Zheng

Kathryn Boys

Zachary Brown

Umut Dur

Harrison Fell

Giuseppe Fiori

Ivan Todorov Kandilov

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Adriana Maria Corredor Waldron

Tamah Morant

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Michael K. Wohlgenant

Economics (MR)

Master of Economics Degree Requirements

Students may select between two of the following degree tracks: Terminal Master's Track and PhD-Prep Track.

Degrees earned will be distributed as: "Master of Economics" without track specifications.

Terminal Master's Track

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECG 561	Applied Econometrics I		
ECG 562	Applied Econometrics II		
ECG 700	Fundamentals of Microeconomics		
ECG 703	Fundamentals of Macroeconomics		
Elective Courses		**12-18**	
See "Elective Courses" listed below			
Other Electives [1]		**0-6**	
"Other Electives" will be determined in conjunction with the academic committee			
Total Hours		**30**	

[1] Students may select any 400-level or above course offered by other departments in conjunction with the academic committee.

Elective Courses

Code	Title	Hours	Counts towards
Select at least four courses of the following:		**12**	
ECG/MA 528	Options and Derivatives Pricing	3	
MA 591	Special Topics	1-6	
ECG/MA 766	Computational Methods in Economics and Finance	3	
ECG 540	Economic Development	3	
ECG 548	International Economics	3	
PS 539	International Political Economy	3	
ECG 515	Environmental and Resource Policy	3	
ECG 715	Environmental and Resource Economics	3	
FOR 519	Forest Economics	3	
ECG 563	Applied Microeconometrics	3	
ECG 750	Introduction to Econometric Methods	3	
ECG 765	Mathematical Methods For Economics	3	
ECG 590	Special Economics Topics	1-6	
ARE 590	Special Topics in ARE	1-99	

PhD-Prep Track

Code	Title	Hours	Counts towards
Core Courses		**12**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ECG 700	Fundamentals of Microeconomics		
ECG 703	Fundamentals of Macroeconomics		
ECG 750	Introduction to Econometric Methods		
ECG 765	Mathematical Methods For Economics		
Elective Courses		**6-12**	
See "Elective Courses" listed below			
Other Electives [1]		**0-6**	
"Other Electives" will be determined in conjunction with the academic committee			
Total Hours		**30**	

[1] Students may select any 400-level or above course offered by other departments in conjunction with the academic committee.

Elective Courses

Code	Title	Hours	Counts towards
Select at least four courses from the following:			
ECG/MA 528	Options and Derivatives Pricing	3	
MA 591	Special Topics	1-6	
ECG/MA 766	Computational Methods in Economics and Finance	3	
ECG 540	Economic Development	3	
ECG 548	International Economics	3	
PS 539	International Political Economy	3	
ECG 515	Environmental and Resource Policy	3	
ECG 715	Environmental and Resource Economics	3	
FOR 519	Forest Economics	3	
ECG 563	Applied Microeconometrics	3	
ECG 590	Special Economics Topics	1-6	
ARE 590	Special Topics in ARE	1-99	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Steven Allen

Alvin B. Brown

Mehmet Caner

Robert L. Clark

Lee A. Clark

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Roger H. Von Haefen

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Economics (MS)

Degree Requirements

Students may select between two of the following degree tracks: Terminal Master of Science Track and PhD-Prep Track.

Degrees earned will be distributed as: "Master of Science" without track specifications.

Terminal Master of Science Track

Code	Title	Hours	Counts towards
Core Courses		**12**	
ECG 561	Applied Econometrics I		
ECG 562	Applied Econometrics II		
ECG 700	Fundamentals of Microeconomics		
ECG 703	Fundamentals of Macroeconomics		
Elective Courses		**12-18**	
See "Elective Courses" listed below			
Other Elective Courses		**0-6**	
"Other Elective Courses" will be determined in conjunction with the academic committee [1]			
Thesis Research Course		**6**	
ECG 695	Master's Thesis Research		
Total Hours		**30**	

[1] Students can take 400-level or above courses offered by other departments determined in conjunction with the academic committee.

Elective Courses

Code	Title	Hours	Counts towards
Select at least four courses from the following:		**12-18**	
ECG 528	Options and Derivatives Pricing	3	
MA 591	Special Topics	1-6	
ECG/MA 766	Computational Methods in Economics and Finance	3	
ECG 540	Economic Development	3	
ECG 548	International Economics	3	
PS 539	International Political Economy	3	
ECG 515	Environmental and Resource Policy	3	
ECG 715	Environmental and Resource Economics	3	
FOR 519	Forest Economics	3	
ECG 563	Applied Microeconometrics	3	
ECG 750	Introduction to Econometric Methods	3	
ECG 765	Mathematical Methods For Economics	3	
ECG 590	Special Economics Topics	1-6	
ARE 590	Special Topics in ARE	1-99	

PhD-Prep Track

Code	Title	Hours	Counts towards
Core Courses		**18**	
ST 501	Fundamentals of Statistical Inference I		
ST 502	Fundamentals of Statistical Inference II		
ECG 700	Fundamentals of Microeconomics		
ECG 703	Fundamentals of Macroeconomics		
ECG 750	Introduction to Econometric Methods		
ECG 765	Mathematical Methods For Economics		
Elective Courses		**6-12**	
See "Elective Courses" listed below			
Other Elective Courses [1]		**0-6**	
"Other Elective Courses" are determined in conjunction with the academic committee			
Thesis Research Course		**6**	
ECG 695	Master's Thesis Research		
Total Hours		**30**	

[1] Students can take 400-level or above courses offered by other departments determined in conjunction with the academic committee.

Elective Courses

Code	Title	Hours	Counts towards
Select at least two of the following courses:		**6-12**	
ECG/MA 528	Options and Derivatives Pricing	3	
MA 591	Special Topics	1-6	
ECG/MA 766	Computational Methods in Economics and Finance	3	
ECG 540	Economic Development	3	
ECG 548	International Economics	3	
PS 539	International Political Economy	3	
ECG 515	Environmental and Resource Policy	3	
ECG 715	Environmental and Resource Economics	3	
FOR 519	Forest Economics	3	
ECG 563	Applied Microeconometrics	3	
ECG 590	Special Economics Topics	1-6	
ARE 590	Special Topics in ARE	1-99	

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Economics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18**	
ECG 701	Microeconomics I		
ECG 702	Microeconomics II		
ECG 704	Macroeconomics I		
ECG 705	Macroeconomics II		
ECG 751	Econometric Methods		
ECG 752	Time Series Econometrics		
or ECG 753	Microeconometrics		
Field Courses		**18**	
Select six of the following courses:			
ECG 706	Industrial Organization		
ECG 707	Topics In Industrial Organization		
ECG 708	Advanced Microeconomic Theory		
ECG 709	Behavioral and Experimental Economics		
ECG 715	Environmental and Resource Economics		
ECG 716	Topics In Environmental and Resource Economics		
ECG 730	Labor Economics		
ECG 739	Empirical Methods for Development Economics and Applied Microeconomics		
ECG 740	Economic Growth and Development		
ECG 741	Agricultural Production and Supply		
ECG 742	Consumption, Demand and Market Interdependency		
ECG 748	Theory Of International Trade		
ECG 749	Monetary Aspects Of International Trade		
ECG 752	Time Series Econometrics		
ECG 753	Microeconometrics		
ECG 766	Computational Methods in Economics and Finance		
ECG 784	Advanced Macroeconomics		
ECG 785	Monetary Economics		
ECG 790	Avanced Special Topics		
Additional 700-level statistics courses may be determined in conjunction with the academic committee			
Dissertation Research Course		**36**	
ECG 895	Doctoral Dissertation Research		
Total Hours		**72**	

1 Four courses must be two 2-course sequences

2 To complete the econometrics field, an ST 700 level course must be taken in addition to ECG 752 Time Series Econometrics and ECG 753 Microeconometrics.

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Michael K. Wohlgenant

Economics (Minor)

Plan Requirements

MS Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
ECG 700	Fundamentals of Microeconomics		
ECG 703	Fundamentals of Macroeconomics		
Select two additional electives in conjunction with the academic committee			
Total Hours		**12**	

PhD Student Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
ECG 700	Fundamentals of Microeconomics		

ECG 703	Fundamentals of Macroeconomics	
Select two electives determined in conjunction with the academic committee		
Select one 700-level elective determined in conjunction with the academic committee		
Total Hours		**15**

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Management

The Poole College of Management offers a Master's degree in Management (MM) that comprises programs that help students build core business skills. The curriculum is designed to give students with a range of backgrounds a strong exposure to core business management skills in a variety of industries. The programs help students develop critical skills in specialized areas, such as marketing analytics. It is designed specifically for students who are looking to create a personal competitive advantage.

Admission Requirements

Applicants are required to complete the standard NC State Graduate School application process. Admission decisions are based on past academic performance and potential, essays, recommendations, relevant work experience and an interview. Applicants are not required to submit GMAT or GRE scores but may choose to do so. International applicants must complete the TOEFL or IELTS. Students can choose to apply for admission in either the Fall or the Spring semester.

Master of Management Degree Requirements

The Master of Management degree requires a total of 30 credit hours, and students must complete all degree requirements within six years.

Marketing Analytics Concentration

The Master of Management (MM), Marketing Analytics concentration is currently offered online as a part-time program and is geared towards students of all backgrounds. Our innovative curriculum focuses on business analytics, marketing and business skills and practical experience – all in a hands-on learning environment. Students will benefit from our faculty's real-world experience, world-class research and industry partnerships to build successful careers in data analytics.

Risk and Analytics Concentration

The Master of Management (MM), Risk and Analytics concentration will be entirely online, and can be completed within 18 - 30 months, part-time. This concentration is targeted to professionals seeking to acquire expected core competencies in risk management and analytical decision-making to be positioned for leadership positions across multiple functions of an organization. The growth in data analytics across all businesses and industries is creating greater demands for individuals with analytic and risk management skills.

Other Relevant Information

While the Master of Management is a fully online program, certain courses may also be offered as in-person classes for students who wish to take evening or daytime classes. Students can apply to start in either the Fall or the Spring semester.

Credits in the MM program can be used toward the MBA. The Working Professional MBA is a 40 hour degree program; 12 MM hours may be counted toward the MBA, subject to approval by an academic advisor. Applicants must understand that completion of the MM program does not guarantee admission to the MBA.

Degrees

- Management (MR): Marketing Analytics Concentration (p. 837)
- Management (MR): Risk and Analytics Concentration (p. 837)

Faculty

Full Professors

Mark S. Beasley

Jonathan D. Bohlmann

Bruce C. Branson

Stacy W. King

Donald Pagach

Associate Professors

Rishika Rishika

Stefanie M. Robinson

Michael A. Stanko

Professors of the Practice

Bonnie V. Hancock

James D. Scalise

Leigh Shamblin

Practice/Research/Teaching Professors

Thomas C. Dow

Management (MR): Marketing Analytics Concentration

Degree Requirements

Code	Title	Hours	Counts towards
Business Analytics Core		**8**	
MBA 506	Data-Driven Managerial Decisions 1		
MBA 507	Data-Driven Managerial Decisions 2		
MBA 551	Predictive Analytics for Business and Big Data		
MBA 552	Data Engineering, Management and Warehousing		
Marketing and Business Skills		**6**	
MBA 560	Marketing Management and Strategy		
MBA 565	Marketing Analytics		
MBA 558	Artificial Intelligence in Management		
Practicum		**3**	
MBA 559	Business Analytics Practicum		
Elective Courses		**13**	
MBA 566	Digital Marketing		
MBA 536	Experience Innovation and Strategic Design		
MBA 561	Consumer Behavior		
MBA 562	Research Methods In Marketing		
MBA 590	Special Topics In Business Management (Marketing Metrics)		
Total Hours		**30**	

Faculty

Full Professors

Jon Bohlmann, *Associate Department Head*
Area of Research: Marketing and Innovation

Stacy Wood
Area of Research: Marketing

Associate Professors

Bill Rand, *Executive Director of Business Analytics Initiative*
Area of Research: Marketing

Stefanie Robinson
Area of Research: Marketing

Mike Stanko
Area of Research: Marketing

Practice/Research/Teaching Professors

Donnie Hale
Area of Research: Business Analytics

Basiru Usman

Poole College of Management's Master of Management with a concentration in Marketing Analytics program is geared towards students of all backgrounds, including recent graduates and working professionals. The program will train students in state of the art data analytic techniques that focus not just on data handling but also on leveraging meaningful data insights that help increase ROI and drive growth. Graduates of the program will make an immediate impact in the workforce with cutting-edge marketing techniques that allow them to handle large amounts of data, use appropriate analytics software and modeling techniques, and implement powerful marketing strategies.

Marketing Analytics graduates can fill a multitude of jobs – data scientists, marketing analysts, market research analysts, predictive analytics analysts, business data analysts, digital marketing specialists, social media analysts and more.

Management (MR): Risk and Analytics Concentration

Admitting for Fall 2022

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**20**	
Risk Management Courses			
MBA 518	Enterprise Risk Management		
BUS 541	Strategic Risk Analysis Using Excel		
BUS 542	Forecasting and Scenario Planning Using Monte Carlo Simulation		

BUS 543	Communicating Risk Information Using Tableau	
ACC 580	Data Analytics in Accounting	
Data Analytics Courses		
MBA 506	Data-Driven Managerial Decisions 1	
MBA 507	Data-Driven Managerial Decisions 2	
MBA 545	Decision Making under Uncertainty	
MBA 551	Predictive Analytics for Business and Big Data	
MBA 552	Data Engineering, Management and Warehousing	
Capstone Course		**3**
MBA 519	Enterprise Risk Management Practicum	
or MBA 559	Business Analytics Practicum	
Elective Courses		**7**
"Elective Courses" are determined in conjunction with the academic committee to meet the 30 total credit hours		
Total Hours		**30**

Elective Courses

Code	Title	Hours	Counts towards
Select seven credit hours of the following:			
Business and Finance			
MBA 501	Financial Accounting for Decision Makers		
MBA 520	Financial Management of Corporations		
MBA 582	Sustainability and Business		
ACC 540	IT Risks and Controls		
Quantitative Risk Analysis			
ECG 528	Options and Derivatives Pricing		
MBA 522	Financial Modeling		
MBA 545	Decision Making under Uncertainty		
MBA 638	Artificial Intelligence (pending Admin Board Approval Fall 2021)		
Leadership and Communications			
MBA 510	Critical Thinking for Managers		
MBA 530	Leading People		
MBA 533	Negotiation and Conflict Management		

Faculty

Full Professors

Jon Bohlmann, *Associate Department Head*
Area of Research: Marketing and Innovation

Stacy Wood
Area of Research: Marketing

Associate Professors

Bill Rand, *Executive Director of Business Analytics Initiative*
Area of Research: Marketing

Stefanie Robinson
Area of Research: Marketing

Mike Stanko
Area of Research: Marketing

Practice/Research/Teaching Professors

Donnie Hale
Area of Research: Business Analytics

Basiru Usman

Individuals will be better positioned for leadership positions across **multiple functions of an organization**, given risk management is becoming an expected core competency.

Professionals with a risk and analytics mindset position themselves strategically for opportunities in a number of fields including: business planning and strategic analysis, innovation and development, logistics and supply chain, compliance oversight, financial analysis and forecasting, enterprise-wide risk management, internal audit, business continuity planning, sustainability and a variety of risk advisory services.

Graduate Certificates - Poole College of Management

Certificates

- Business Analytics (Certificate) (p. 822)
- Business Leadership (Certificate) (p. 823)

- Finance (Certificate) (p. 824)
- Marketing (Certificate) (p. 824)
- Operations and Supply Chain Management (Certificate) (p. 825)
- Tax Analytics and Technology (Certificate) (p. 815)
- Technology Entrepreneurship and Commercialization (Certificate) (p. 826)

Finance (Certificate)

Through theory and applied learning, students come to understand the relationship between capital providers (investing households), capital markets (stocks and bonds), and capital users (firms). Students use real-world tools, such as stock price databases and spreadsheet analysis, to apply theory to practice. This flexible option is ideal for professionals who want to gain a foundational understanding of financial management.

Admissions requirements

Graduate certificate programs are open to NC State MBA students and Master of Management of Marketing Analytics students or to others who are not currently enrolled at NC State with a bachelor's degree from an accredited college or university. The TEC certificate is available for all applicants, including other graduate students at NC State University.

- Four year bachelor's degree (or US degree equivalent) from a regionally accredited college or university.
- Maintained a minimum GPA of 3.0 across all certificate-counting classes in undergraduate and graduate work (some exceptions are available for those with graduate studies).
- Two years of full-time, post-baccalaureate professional employment is required for applicants to certificate programs.
- Standardized test scores (GMAT, GRE) are not required to apply to a graduate management certificate program.

International applicants who are not in a graduate program at NC State must take the TOEFL or IELTS unless they qualify for a waiver.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**3**	
MBA 501	Financial Accounting for Decision Makers		
MBA 520	Financial Management of Corporations		
Elective Courses		**9**	
Select nine credit hours of coursework from the following:			
MBA 521	Advanced Corporate Finance		
MBA 522	Financial Modeling		
MBA 523	Investment Theory and Practice		
MBA 524	Equity Valuation		
MBA 525	Taxes and Business Strategy		
MBA 526	International Finance		
MBA 590	Special Topics In Business Management (Private Equity Venturing)		
Total Hours		**12**	

Marketing (Certificate)

The Marketing Certificate is an innovative option for professionals who want to become skilled in a field that significantly impacts every other industry. Students focus on seeking, identifying and creating business opportunities, developing products/services, and building/maintaining customer relationships while discovering the skills and tools needed to succeed in today's marketing climate.

Admission requirements

For admission requirements, please visit the admissions website (https://mba.ncsu.edu/academics/certificate-programs/admissions-2/). Please note that current graduate students at NC State may not dual enroll into this certificate.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**5**	
MBA 560	Marketing Management and Strategy		
MBA 561	Consumer Behavior		
Marketing Elective		**1**	
Select a marketing elective approved in conjunction with the academic committee			
Research Elective		**3**	

Select one of the following:		
MBA 562	Research Methods In Marketing	
MBA 565	Marketing Analytics	
MBA 566	Digital Marketing	
Additional Elective		**3**
Select one of the following:		
MBA 562	Research Methods In Marketing [1]	
MBA 563	Product and Brand Management	
MBA 564	Business Relationship Management	
MBA 565	Marketing Analytics	
MBA 566	Digital Marketing	
Total Hours		**12**

[1] If not taken as the research-oriented course

Operations and Supply Chain Management (Certificate)

The Operations and Supply Chain Management Certification program provides students with in-depth knowledge of the entire supply chain process, from raw materials to finished products. With an emphasis on information and supply flow, students develop the skills needed to write comprehensive management reports, manage teams of workers, and make persuasive management presentations.

Admission requirements

- Four year bachelor's degree (or US degree equivalent) from a regionally accredited college or university.
- Maintained a minimum GPA of 3.0 across all certificate-counting classes in undergraduate and graduate work (some exceptions are available for those with graduate studies).
- Two years of full-time, post-baccalaureate professional employment is required for applicants to certificate programs.
- Standardized test scores (GMAT, GRE) are not required to apply to a graduate management certificate program.

International applicants who are not in a graduate program at NC State must take the TOEFL or IELTS unless they qualify for a waiver.

Please note that current graduate students at NC State may not dual enroll into this certificate.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Prerequisites			
MBA 506	Data-Driven Managerial Decisions 1		
MBA 507	Data-Driven Managerial Decisions 2		
Required Courses		**2**	
MBA 540	Principles of Operations and Supply Chain Management		
Elective Courses		**10**	
Select 10 hours of courses from the following:			
MBA 541	Supply Management		
MBA 542	Supply Chain Logistics		
MBA 543	Planning and Control Systems		
MBA 545	Decision Making under Uncertainty		
MBA 548	Analytical Supply Chain Management		
MBA 549	Supply Chain Management Practicum		
MBA 590	Special Topics In Business Management (Healthcare Supply Chain Analytics)		
MBA 590	Special Topics In Business Management (Operations Analysis)		
MBA 590	Special Topics In Business Management (Strategic Operations)		
MBA 590	Special Topics In Business Management (Operations Models & Applications)		

MBA 590	Special Topics In Business Management (Strategic Supply Chain Management)	
MBA 590	Special Topics In Business Management (Managing Operations)	
Total Hours		**12**

Tax Analytics and Technology (Certificate)

The Graduate Certificate in Tax Analytics and Technology is currently a two to three year online program that targets for enrollment MAC and MBA graduate students at NC State, graduate students at other universities and working professionals in the Research Triangle, national and global community. They will learn knowledge and skills to extract, manipulate, analyze, and summarize tax data to solve tax problems, identify opportunities for tax savings, and to effectively communicate actionable tax and business strategies to organizations.

Admissions Requirements

Graduate students at NC State must be in good standing. Students not enrolled at NC State must have completed a baccalaureate degree and have either taken some introductory/intermediate accounting and tax courses or have work experience in these areas. All students must submit an application to the certificate program which will be reviewed and evaluated by the coordinator. A minimum GPA of 3.0 (in undergraduate and/or prior graduate work) is required for admission to the program.

Program Requirements

The certificate program requires students to complete twelve (12) one-credit hour online courses with an overall 3.0 GPA in all courses. No transfer credits will be accepted in the program and it must be completed within four years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework from the following:			
ACC 560	Tools for Tax Analytics		
ACC 561	Database Management in Tax		
ACC 562	Forecasting Effective Tax Rates and Scenario Analysis - Introduction		
ACC 563	Forecasting Effective Tax Rates and Scenario Analysis - Advanced Application		
ACC 564	Project Management and Process Documentation in Tax		
ACC 565	Visual Analytics in Tax		
ACC 566	Database Management Applications in Tax		
ACC 569	Advanced Visual Analytics in Tax		
ACC 570	Data Security and Warehousing in Tax		
Elective Courses		**3**	
Select three hours of coursework from the following:			
BUS 590	Special Topics In Business Management (Forecasting and Scenario Planning Using Monte Carlo)		
BUS 590	Special Topics In Business Management (Creating Management Dashboards Using Tableau)		
MBA 506	Data-Driven Managerial Decisions 1		
MBA 507	Data-Driven Managerial Decisions 2		
MBA 511	Data Security and Privacy		
MBA 545	Decision Making under Uncertainty		
MBA 551	Predictive Analytics for Business and Big Data		
Total Hours		**12**	

Technology Entrepreneurship and Commercialization (Certificate)

The Technology Entrepreneurship and Commercialization certificate program provides students with a proven approach to evaluating technologies and bringing technology innovations to market. Students who complete the TEC certificate are equipped to evaluate technologies, create and develop product ideas, and construct business proposals.

Program Requirements

The certificate program requires students to complete twelve (12) credit hours with an overall 3.0 GPA in all certificate courses. Credit toward the certificate in a particular course will be given only if a grade of B- or better is earned in that course. All courses in the program must be taken for a letter grade. No transfer credits will be accepted in the program and it must be completed within three years.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
MBA/MSE 576	Technology Entrepreneurship and Commercialization I		
MBA/MSE 577	Technology Entrepreneurship and Commercialization II		
Elective Courses		**6**	
Select two of the following:			
MBA 555	Product Design and Development		
MBA 572	Venture Opportunity Analytics		
MBA 578	Venture Launch		
MBA 579	Entrepreneurship Clinic Practicum		
Total Hours		**12**	

Wilson College of Textiles

Programs

- Fiber & Polymer Science (p. 842)
- Textile Chemistry (p. 847)
- Textile Engineering (p. 853)
- Textile Technology Management (p. 858)
- Textiles (p. 862)

Degree Programs

Master of Science (MS)

- Textile Chemistry (MS) (p. 848)
- Textile Engineering (MS) (p. 854)

Doctor of Philosophy (PhD)

- Fiber and Polymer Science (PhD) (p. 844)
- Textile Technology Management (PhD) (p. 860)

Minors

- Textile and Apparel Management (Minor) (p. 868)
- Textile Chemistry (Minor) (p. 852)
- Textile Engineering (Minor) (p. 857)

Certificates

- Consumer Textile Product Design and Development (Certificate) (p. 869)
- Nonwoven Science and Technology (Certificate) (p. 871)
- Textile Brand Management and Marketing (Certificate) (p. 869)
- Textile Supply Chain Management (Certificate) (p. 858)

Fiber & Polymer Science

This multidisciplinary program brings together the disciplines of mathematics, chemistry, physics, and engineering for the development of the independent scholars versed in the fields of polymer, fiber, and textile science. The program is coordinated by the Wilson College of Textiles and leads to the degree of Doctor of Philosophy.

The polymer, fiber, and textile sciences are concerned with polymeric materials and fibers produced from them; textile assemblies in one, two, and three-dimensional forms; and the chemistry of dyeing, finishing, and other wet processes. This broad field of study permits a wide range of useful concentrations. The candidate is expected to concentrate in one area and to acquire a reasonable perspective in other relevant areas. Generally, a student specializes in the areas of (1) polymer chemistry and synthesis, (2) fiber and polymer physics and physical chemistry, (3) the production, processing and properties of fibrous materials, or (4) chemistry of dyes, finishes, and their processes. The student's research is usually based within one of these areas or another suitable one.

Admission Requirements

Students with a Master of Science (M.S.) degree in a related field may apply to the Fiber and Polymer Science program. Typically the minimum acceptable overall grade point average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students without a master's degree may also apply if met the following conditions:

1. the undergraduate degree from a well-known and robust research active program with a cumulative GPA of 3.5 or above;
2. strong recommendation letters from faculty adviser(s) indicating research experience or suggesting research potential; and
3. strong publication record/experience or extensive industry experience in related industry/profession.

Applicants should plan to take the GRE or GMAT examination, which is required for all applicants. The GRE/GMAT scores should be sent to NC State University electronically and be available online.

For International students, TOEFL or IELTS is required for the application. Students must rank in a competitive percentile in order to be considered for acceptance into NC State University.

- TOEFL: A total score of 80+ on IBT. Minimum scores of 18 points for each section: or
- IELTS: An overall band score of 6.5+. Minimum scores of 6.5 points for each section

Scholarships and Assistantships

Competitive scholarships and assistantships from the program as well we as the University are available to incoming new students. All incoming students will be considered for the funding opportunities. No separate application for assistantships/scholarships is needed.

Degrees

- Fiber and Polymer Science (PhD) (p. 844)

Faculty

Full Professors

Harald Ade

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Kavita Mathur

Lokendra Pal

Lisa Parrillo-Chapman

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Mansour H. Mohamed

William Oxenham

Nancy Powell

Suzanne Townsend Purrington

William C. Stuckey Jr

Carl B. Smith

Gary W. Smith

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Mohamad Samir Midani

Behnam Pourdeyhimi

Orlando Jose Rojas

Gisela de Aragao Umbuzeiro

Antony Williams

Julie Ann Willoughby

Bong-Yeol Yeom

Fiber and Polymer Science (PhD)

Degree Requirements

The Ph.D. degree in Fiber and Polymer Science symbolizes the ability of the recipient to undertake original and scholarly work at the highest levels without supervision. The degree is, therefore, not granted simply upon the completion of a stated amount of course work but rather upon demonstration by the student of a comprehensive knowledge base and high attainment in scholarship. The student demonstrates this ability by passing a series of courses, creating a written critical literature review and original research proposal, defending an oral preliminary examination, writing a dissertation reporting the results of an original investigation, and making a final oral defense of the research before the student's advisory committee and other interested members of the University community.

Code	Title	Hours	Counts towards
Required Courses		**14**	
FPS 801	Seminar [1]		
FPS 770	Advances in Polymer Science [2]		

TMS 762	Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures [2]	
Select two additional Courses from the following: [2]		
Polymer Science		
TC 771	Polymer Microstructures, Conformations and Properties	
Fiber Science		
TC 704	Fiber Formation--Theory and Practice	
TMS 761	Mechanical and Rheological Properties Of Fibrous Material	
TMS 763	Characterization Of Structure Of Fiber Forming Polymers	
Coloration and Wet Processing		
TC 706 & TC 707	Color Science and Color Laboratory	
TC/FPS 710	Science of Dye Chemistry, Dyeing, Printing and Finishing	
TC 720	Chemistry Of Dyes and Color	
Formation and Properties of Textile Products		
FPS 750	Advances in Fabric Formation, Structure, and Properties	
Additional Courses		**58**
"Elective Courses" that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee		
Total Hours		**72**

1 All students must take two (2) semesters of FPS 801 Seminar.

2 Every student must obtain a grade of B or better in each of the four qualifying courses chosen.

Additional Requirements

- A minimum of 72 credit hours is required of students entering the program with a B.S. degree, or a minimum of 54 credit hours beyond the M.S. degree is required. (Students, who enter the Ph.D. program directly upon completion of an M.S. at NC State, may be allowed credit for up to 30 hours of their M.S. and thus would require 42 additional credit hours to complete the Ph.D.)
- Most of these credit hours are expected to be research credits (FPS 893 Doctoral Supervised Research or FPS 895 Doctoral Dissertation Research).
- Following successful course completion, the student needs to pass the defense of a research proposal to obtain the candidacy for the Ph.D degree.
- The final examination is an oral exam where the student presents and defends her/his research procedures, results and conclusions. The presentation will be made to an examining committee consisting of the student's advisory committee and is open to interested faculty, staff and students. After the presentation the student will be orally examined by the examining committee. The final oral examination can be scheduled once all coursework requirements have been fulfilled and the committee is satisfied that the dissertation is complete, but not earlier than one semester after admission to candidacy.
- The anticipated time for completion of the Ph.D. program is four years for a student entering from a B.S. degree and three years for entry from an M.S. degree. The minimum time required (in exceptional cases) is two years beyond entry if the student obtained an M.S. degree from NC State.

Faculty

Full Professors

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Julie Ann Willoughby

Bong-Yeol Yeom

Textile Chemistry

Degree Requirements Master of Science in Textile Chemistry (MS/TC)

The Masters of Science in Textile Chemistry (MS TC) has two options, a thesis option (Option A) and a non-thesis option (Option B).

M.S. TC Option A (Thesis Degree) Program Requirements

MS TC Option A (Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial ***chemistry*** content, mostly CH or TC, or from the approved TC offerings table. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. *Note: not all courses with these prefixes are offered by the TECS Department*;
- Two semesters of TC601 (Graduate Seminar) are required;
- For the thesis a minimum of six hours of thesis related research is required (TC 695, TC693 or TC630).

Master's Thesis. The Master's thesis should be a research exercise that necessitates expertise at the M.S. level and is concentrated in the textile chemistry area on a well-defined topic that has a restricted scope.

M.S. TC Option B (Non-Thesis Degree) Program Requirements

MS TC Option B (Non-Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial ***chemistry*** content, mostly CH or TC, or from the approved TC offerings table. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. *Note: not all courses with these prefixes are offered by the TECS Department*;
- Two semesters of TC601 (Graduate Seminar) are required;
- At least six credit hours of project-related work in textile chemistry at the 600 level or above, such as TC 630 (Independent Study) or an internship, which will be advised by and evaluated by at least one Graduate Faculty Member in Textile Chemistry.

Degrees

- Textile Chemistry (MS) (p. 848)
- Textile Chemistry (Minor) (p. 852)

Faculty

Full Professors

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Gisela de Aragao Umbuzeiro

Textile Chemistry (MS)

Master of Science Degree Requirements

Students are required to take a total of 8 courses (24 credits of graded coursework), meeting criteria #1 and #2 below, courses may count toward both criteria (e.g. all TE and some TC courses). Additional courses must be of the graduate level (500-level or above) and be relevant to the field of study.

Code	Title	Hours	Counts towards
TECS Core Courses		**15**	
Criteria #1 [1]			
See "Criteria #1" listed below			
Engineering Content Courses		**12**	
Criteria #2			
See "Criteria #2" listed below			
TECS Seminar		**2**	
TC 601	Seminar		
TC 601	Seminar		
Research / Independent Studies		**6-9**	
Select either "Option A" or "Option B"			
Option A [2]			
TC 630	Independent Study		
TC 693	Master's Supervised Research		
TC 695	Master's Thesis Research		
TC 696	Summer Thesis Research		
Option B [3]			
TC 630	Independent Study		
TC 630	Independent Study		
Total Hours		**32-36**	

[1] The TC and some TE/FPS courses may also count towards criteria #2 as listed there

[2] At least 6 credits of research or independent study courses, the first 6 credits are always recommended to be TC 630

[3] 6 credits of independent study

Criteria #1

Code	Title	Hours	Counts towards
Select a minimum of five courses from the TECS faculty-taught courses listed below		15	
Total Hours		**15**	

TC PREFIX

Code	Title	Hours	Counts towards
500-Level Courses			
TC 530	The Chemistry Of Textile Auxiliaries		
TC 561	Organic Chemistry Of Polymers		
TC 565	Polymer Applications and Technology		
TC 589	Special Studies In Textile Engineering and Science		
700-Level Courses			
TC 704	Fiber Formation--Theory and Practice		
TC 705	Theory Of Dyeing		
TC 706	Color Science		
TC 707	Color Laboratory		
TC 710	Science of Dye Chemistry, Dyeing, Printing and Finishing	3	
TC 720	Chemistry Of Dyes and Color		
TC 771	Polymer Microstructures, Conformations and Properties		
TC 791	Special Topics In Textile Science		
TC 792	Special Topics In Fiber Science		

TE PREFIX

Code	Title	Hours	Counts towards
500-Level Courses			
TE 505	Textile Systems and Control		
TE 533	Lean Six Sigma Quality		
TE 540	Textile Information Systems Design	4	
TE 550	Clothing Comfort and Personal Protection Science		
TE 551	Human Physiology for Clothing and Wearables		
TE 562	Simulation Modeling	3	
TE 565	Textile Composites		
TE 566	Polymeric Biomaterials Engineering	3	
TE 570	Polymer Physics		
TE 589	Special Studies In Textile Engineering and Science		

TT PREFIX

Code	Title	Hours	Counts towards
500-Level Courses			
TT 503	Materials, Polymers, and Fibers used in Nonwovens		
TT 504	Introduction to Nonwovens Products and Processes	3	
TT 505	Advanced Nonwovens Processing	3	
TT 507	Nonwoven Characterization Methods		
TT 508	Nonwoven Product Development	3	
TT 520	Yarn Processing Dynamics		
TT 521	Filament Yarn Production Processing and Properties		
TT 530	Textile Quality and Process Control		
TT 532	Evaluation of Biotextiles		

TT 533	Lean Six Sigma Quality		
TT 581	Technical Textiles		

OTHER PREFIXES

Code	Title	Hours	Counts towards
500-Level Courses			
TTM 501	Textile Enterprise Integration		
700-Level Courses			
TMS 761	Mechanical and Rheological Properties Of Fibrous Material		
TMS 762	Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures	3	
TMS 763	Characterization Of Structure Of Fiber Forming Polymers		
FPS 710	Science of Dye Chemistry, Dyeing, Printing and Finishing	3	
FPS 750	Advances in Fabric Formation, Structure, and Properties	3	
FPS 770	Advances in Polymer Science	3	

Criteria #2

Code	Title	Hours	Counts towards
Select a minimum of four courses from the Engineering graduate-level classes		12	
TC 500+	Any graded (non-research) TC course at the 500 level or higher		
Chemistry 500+	Any graded (non-research) Chemistry course at the 500-level or higher, such as, but not limited to prefixes: CH and CHE		
See "Additional Course Options" listed below for approved exceptions in other areas			
Total Hours		**12**	

Additional Course Options

Code	Title	Hours	Counts towards
TT/NW 503	Materials, Polymers, and Fibers used in Nonwovens		
TE/PY 570	Polymer Physics		
TMS 762	Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures		
TMS/MSE 763	Characterization Of Structure Of Fiber Forming Polymers		
FPS 710	Science of Dye Chemistry, Dyeing, Printing and Finishing		
FPS 770	Advances in Polymer Science		
BCH 751	Biophysical Chemistry		
FB 516	Forest Products Colloids & Surfaces		
FB 723	Forest Biomaterials Chemistry		
MSE 565	Introduction to Nanomaterials		
MSE/CHE 761	Polymer Blends and Alloys		
MSE 775	Structure of Semicrystalline Polymers		
CHE/BEC 562	Fundamentals of Bio-Nanotechnology		

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate

School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Full Professors

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Behnam Pourdeyhimi

Gisela de Aragao Umbuzeiro

Textile Chemistry (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Hechmi Hamouda

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Emeritus Faculty

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Perry L. Grady

Bhupender S. Gupta

Gary N. Mock

Mansour H. Mohamed

Carl B. Smith

Michael Herbert Theil

Charles Tomasino

Adjunct Faculty

Behnam Pourdeyhimi

Gisela de Aragao Umbuzeiro

Textile Engineering

Degree Requirements Master of Science in Textile Chemistry (MS/TE)

The Masters of Science in Textile Engineering (MS TE) has two options, a thesis option (Option A) and a non-thesis option (Option B).

M.S. TE Option A (Thesis Degree) Program Requirements

MS TE Option A (Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial ***engineering*** content, including courses with TE and TMS prefixes. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. *Note: not all courses with these prefixes are offered by the TECS Department*;
- Two semesters of TE601 (Graduate Seminar) are required;
- For the thesis a minimum of six hours of thesis related research is required (TE 695, TE693 or TE630).

Master's Thesis. The Master's thesis should be a research exercise that necessitates expertise at the M.S. level and is concentrated in the textile engineering area on a well-defined topic that has a restricted scope.

M.S. TE Option B (Non-Thesis Degree) Program Requirements

MS TE Option B (Non-Thesis) requires a minimum of 32 credit hours, with a minimum of 24 credit hours (8 courses) meeting the following requirements:

- At least 12 credit hours of courses with substantial ***engineering*** content, including courses with TE and TMS prefixes. Substitutions must be approved by the Director of Graduate Programs;
- A minimum of 15 credit hours of courses that are offered by the TECS Department, which may have the following prefixes: TC (PCC), TE, TMS, NW, TT, FPS, and TTM. *Note: not all courses with these prefixes are offered by the TECS Department*;
- Two semesters of TE601 (Graduate Seminar) are required;
- At least six credit hours of project-related work in textile engineering at the 600 level or above, such as TE 630 (Independent Study) or an internship, which will be advised by and evaluated by at least one Graduate Faculty Member in Textile Engineering.

Degrees

- Textile Engineering (MS) (p. 854)
- Textile Engineering (Minor) (p. 857)
- Textile Supply Chain Management (Certificate) (p. 858)

Faculty

Roger L. Barker

Ahmed El-Shafei

Harold S. Freeman

David Hinks

Tushar K. Ghosh

Russell E. Gorga

Peter J Hauser

Samuel Mack Hudson

Warren J. Jasper

Jeffrey Allen Joines

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Carl B. Smith

Moon Won Suh

Michael Herbert Theil

Adjunct Faculty

Gisela de Aragao Umbuzeiro

Textile Engineering (MS)

Master of Science Degree Requirements

Students are required to take a total of 8 courses (24 credits of graded coursework), meeting criteria #1 and #2 below, courses may count toward both criteria (e.g. all TE and some TC courses). Additional courses must be of the graduate level (500-level or above) and be relevant to the field of study.

Code	Title	Hours	Counts towards
TECS Core Courses		**15**	
Criteria #1 [1]			
See "Criteria #1" listed below			
Engineering Content Courses		**12**	
Criteria #2			
See "Criteria #2" listed below			
TECS Seminar		**2**	
TE 601	Seminar		
TE 601	Seminar		
Research / Independent Studies		**6-9**	
Select either "Option A" or "Option B"			
Option A [2]			
TE 630	Independent Study		
TE 693	Master's Supervised Research		
TE 695	Master's Thesis Research		
TE 696	Summer Thesis Research		
Option B [3]			
TE 630	Independent Study		
TE 630	Independent Study		
Total Hours		**32-36**	

1 The TE courses may also count towards criteria #2 as listed there

2 At least 6 credits of research or independent study courses, the first 6 credits are always recommended to be TC 630

3 6 credits of independent study

Criteria #1

Code	Title	Hours	Counts towards
Select a minimum of five courses from the TECS faculty-taught courses listed below		15	
Total Hours		**15**	

TC Prefix

Code	Title	Hours	Counts towards
500-Level Courses			
TC 530	The Chemistry Of Textile Auxiliaries	3	
TC 561	Organic Chemistry Of Polymers	3	
TC 565	Polymer Applications and Technology	3	
TC 589	Special Studies In Textile Engineering and Science	1-4	
700-Level Courses			
TC 704	Fiber Formation--Theory and Practice	3	
TC 705	Theory Of Dyeing	3	
TC 706	Color Science	3	

TC 707	Color Laboratory	1
TC 710	Science of Dye Chemistry, Dyeing, Printing and Finishing	3
TC 720	Chemistry Of Dyes and Color	3
TC 771	Polymer Microstructures, Conformations and Properties	3
TC 791	Special Topics In Textile Science	1-6
TC 792	Special Topics In Fiber Science	1-6

TE Prefix

Code	Title	Hours	Counts towards
500-Level Courses			
TE 505	Textile Systems and Control	3	
TE 533	Lean Six Sigma Quality	3	
TE 540	Textile Information Systems Design	4	
TE 550	Clothing Comfort and Personal Protection Science	3	
TE 551	Human Physiology for Clothing and Wearables	3	
TE 562	Simulation Modeling	3	
TE 565	Textile Composites	3	
TE 566	Polymeric Biomaterials Engineering	3	
TE 570	Polymer Physics	3	
TE 589	Special Studies In Textile Engineering and Science	1-4	

TT Prefix

Code	Title	Hours	Counts towards
500-Level Courses			
TT 503	Materials, Polymers, and Fibers used in Nonwovens	3	
TT 504	Introduction to Nonwovens Products and Processes	3	
TT 505	Advanced Nonwovens Processing	3	
TT 507	Nonwoven Characterization Methods	3	
TT 508	Nonwoven Product Development	3	
TT 520	Yarn Processing Dynamics	3	
TT 521	Filament Yarn Production Processing and Properties	3	
TT 530	Textile Quality and Process Control	3	
TT 532	Evaluation of Biotextiles	3	
TT 533	Lean Six Sigma Quality	3	
TT 581	Technical Textiles	3	

oTHER prEFIXES

Code	Title	Hours	Counts towards
500-Level Courses			
TTM 501	Textile Enterprise Integration	3	
700-Level Courses			
TMS 761	Mechanical and Rheological Properties Of Fibrous Material	3	
TMS 762	Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures	3	
TMS 763	Characterization Of Structure Of Fiber Forming Polymers	3	
FPS 710	Science of Dye Chemistry, Dyeing, Printing and Finishing	3	
FPS 750	Advances in Fabric Formation, Structure, and Properties	3	

FPS 770	Advances in Polymer Science	3

Criteria #2

Code	Title	Hours	Counts towards
Select a minimum of four courses from the Engineering graduate-level classes		12	
TE 500+	Any graded (non-research) TE/TMS course at the 500 level or higher		
Engineering 500+	Any graded (non-research) Engineering course at the 500-level or higher, such as, but not limited to prefixes: CHE, MSE, NE, BME, ENG, CSC, etc.		
Total Hours		**12**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Roger L. Barker

Ahmed El-Shafei

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Adjunct Faculty

Gisela de Aragao Umbuzeiro

Textile Engineering (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

Faculty

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Gisela de Aragao Umbuzeiro

Textile Supply Chain Management (Certificate)

The Graduate Certificate Program in Textile Supply Chain Management provides NC State graduate students the opportunity to develop recognized academic credentials in this concentration in addition to their major area of graduate study. The Certificate also provides non-degree graduate-level students the opportunity to develop recognized advanced expertise in Textile Supply Chain Management.

Admission

Applicants must meet one of the 3 following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in a NC State University graduate program; and
- Have a Master's degree.

Provisional Admission

Applicants who do not meet the GPA requirements may be admitted provisionally based on past work experiences as a professional in textiles or a textile related field. Supporting documentation of professional experience in textiles should be submitted for provisional admission. Students who are admitted provisionally must earn at least a "B" average in the first three courses of the certificate program in order obtain full admission into the certificate program.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
TTM 501	Textile Enterprise Integration	3	
TTM 761	Supply Chain Management and Information Technology	3	
TE 533	Lean Six Sigma Quality [1]	3	
or TE 540	Textile Information Systems Design		
Select two of the following advanced courses:		6	
TTM 530	Textile Quality and Process Control		
TTM 583	Strategic Planning for Textile Firms		
TTM 588	Global Perspectives in Textiles Supply Chain Management (USA)		
Total Hours		**15**	

[1] either or both - spare will be used as an "advanced course"

Textile Technology Management

The Ph.D. in Textile Technology Management program is designed to educate students for research and management careers in textile technology management in the fiber, textile, apparel, retail and related industries complex, as well as for positions in government and academe.

Numerous competitive challenges are facing the global textile complex. There is a need for industry and government leaders who can provide knowledge of products, processes and business strategies to effectively position companies to compete in this global marketplace. The Ph.D. in Textile Technology Management program is designed to educate students for research and management careers in textile technology management in the fiber, textile, apparel, retail and related industries complex, as well as for positions in government and academe.

The graduates of this program are expected to play several roles in industry, government, and other institutions, including:

1. Carrying out research on issues that relate to the technologies of design, characterization, and manufacture of fibers and fibrous products, management of production and sourcing activities, marketing and distribution of products, international trade, and information requirements. The plethora of raw materials and product specific technologies extant in the industry coupled with the rapid rate at which these technologies are changing challenge students in the program to be innovative in approaches to product development, processes, and strategic business practices. Graduates assume positions in the industry with prime responsibilities for developing policy alternatives for strategic and long range planning.
2. Contributing to the teaching and research in institutions concerned with fiber, textile, apparel, and retail programs.
3. Developing policies at the highest level where broad technical and managerial expertise is required to ensure proper decision-making.

The educational objectives of the TTM Ph.D. program are two-fold:

1. To prepare managers for the research and technological enterprises within the fiber, textile, apparel, retail and related industries. To

achieve this objective, the programs of study will be designed for each student to acquire and integrate knowledge of the materials and technologies used in the industrial complex by applying those quantitative, qualitative, and analytical techniques of management that would be most useful for their career goals.

2. To prepare graduates to be faculty members in the numerous international colleges and universities.

Admission Requirements

Students with a Master of Science (M.S.) degree in a related field may apply to the Textile Technology Management program. Typically the minimum acceptable overall grade point average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students without a master's degree may also apply if met the following conditions:

1. the undergraduate degree from a well-known and robust research active program with a cumulative GPA of 3.5 or above;
2. strong recommendation letters from faculty adviser(s) indicating research experience or suggesting research potential; and
3. strong publication record/experience or extensive industry experience in related industry/profession.

Applicants should plan to take the GRE or GMAT examination, which is required for all applicants. The GRE/GMAT scores should be sent to NC State University electronically and be available online.

For International students, TOEFL or IELTS is required for the application. Students must rank in a competitive percentile in order to be considered for acceptance into NC State University and our department.

- TOEFL: A total score of 80+ on IBT. Minimum scores of 18 points for each section: or
- IELTS: An overall band score of 6.5+. Minimum scores of 6.5 points for each section

Scholarships and Assistantships

Competitive scholarships and assistantships from the program as well we as the University are available to incoming new students. All incoming students will be considered for the funding opportunities. No separate application for assistantships/scholarships is needed.

Degrees

- Textile Technology Management (PhD) (p. 860)

Roger Barker

Keith Beck

Timothy Clapp

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Stephen Michielsen

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Charles Tomasino

James Wilson

Samuel Winchester

Genevieve Garland

Abhay Sham Joijode

Mohamad Samir Midani

Samuel Moore

Behnam Pourdeyhimi

Antony J. Williams

Julie Ann Willoughby

Bong-Yeol Yeom

Textile Technology Management (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Qualifying Courses		**12**	
TTM 710	Textile Technology Management		
TTM 785	Doctoral Research Methods		
TTM 750	Advances in Fabric Formation, Structure, and Properties		
TTM 731	Decision Models and Applications in Textile and Apparel Management		
Seminar Courses		**2**	
TTM 801	Seminar [1]		
Additional Courses [2]		**6**	
	"Additional Courses" are approved in conjunction with the academic committee		
Elective Courses		**52**	

"Elective Courses" that will be applied to reach 72 credit hours will be determined in conjunction with the academic committee	
Total Hours	**72**

1 All students must complete two (2) semesters of TTM 801 Seminar (which may be waived for students who have taken TC 601 Seminar, TE 601 Seminar, or TT 601 Seminar during their master's program at NC State).

2 Additionally, all students need to take a minimum of two (2) additional courses, which should be selected with input from the advisory committee and can be part of an "official minor", which will require approval from the Minor Director of Graduate Programs, or can be courses chosen to provide a better foundation for the research work.

Additional Requirements

- A minimum of 72 credit hours is required of students entering the program with a B.S. degree, or a minimum of 54 credit hours beyond the M.S. degree is required. (Students, who enter the Ph.D. program directly upon completion of an M.S. at NC State, may be allowed credit for up to 30 hours of their M.S. and thus would require 42 additional credit hours to complete the Ph.D.) Most of these credit hours are expected to be research credits (TTM 893 Doctoral Supervised Research or TTM 895 Doctoral Dissertation Research).
- Following successful course completion, the student needs to pass the defense of a research proposal to obtain the candidacy for the Ph.D degree.
- The final examination is an oral exam where the student presents and defends her/his research procedures, results and conclusions. The presentation will be made to an examining committee consisting of the student's advisory committee and is open to interested faculty, staff and students. After the presentation the student will be orally examined by the examining committee. The final oral examination can be scheduled once all coursework requirements have been fulfilled and the committee is satisfied that the dissertation is complete, but not earlier than one semester after admission to candidacy.
- The anticipated time for completion of the Ph.D. program is four years for a student entering from a B.S. degree and three years for entry from an M.S. degree. The minimum time required (in exceptional cases) is two years beyond entry if the student obtained an M.S. degree from NC State.

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Abhay Sham Joijode

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Antony J. Williams

Julie Ann Willoughby

Bong-Yeol Yeom

Textiles

NC State's College of Textiles, and the Department of Textile and Apparel, Technology and Management (TATM), prepares future leaders for the textile, apparel, home/furniture, fashion and retail industries. Based in Raleigh, North Carolina, undergraduate and graduate programs (Fashion and Textile Management; Fashion and Textile Design) incorporate global marketplace dynamics with a strategic management focus. Our graduates incorporate "art/design" + "science/technology" + "management" concepts in creative problem-solving. Our program is equipped with access to and experiences utilizing the latest industry technologies. The majority of the students have an enriching and intensive study abroad experience. Our program faculty works closely with industry partners, including the Department's 24-member Industry Advisory Board, to develop academic and experiential "real world" learning experiences. Student internships combined with a global alumni network provide an additional "value-added" experience, with our students prepared to make an immediate impact in diverse companies throughout the global supply chain. Career paths of our graduates are in the areas of: brand marketing, merchandising, retail, sourcing, private brand development, market analyst, design, product development, supply chain, and public relations and communications.

Degrees are distributed as "Master of Textiles" and "Master of Science" without pathway specifications.

Master of Science in Textiles Degree

The objective of the Master of Science (MS) in Textiles is to prepare students for careers that require independent research skills, including designing, planning, and carrying out research projects. Students can choose to focus their studies in one of the following areas of specializations: Textile and Fashion Design, Retail and Brand Management, Textile Technology, and Textile Management. The MS degree requires a minimum of 36 hours of study including a thesis and typically takes 2 years to complete. Students interested in continuing with a Ph.D. in Textile Technology and Management (TTM) or Fiber and Polymer Science (FPS) are encouraged to pursue the MS degree.

Master of Textiles Degree

The Non-Thesis Master of Textiles (MT) program offers preparation and career advancement for students with interests in the design, management, and technological perspectives of the textile industry. The program is available on campus and online via Distance Education (DE) with flexibility to accommodate a breadth of student needs. The MT degree requires a minimum of 30 credit hours and can be completed in only two semesters (1 year) of full-time on campus study or up to a maximum of six (6) years for part time on-campus or DE students.

Accelerated Bachelor's and Master's Degrees

The Accelerated Bachelor's and Master's (ABM) degrees in the Department of Textile and Apparel, Technology and Management (TATM) are designed to provide exceptional undergraduate students in the Fashion and Textile Management (FTM) and Fashion and Textile Design (FTD) programs with the opportunity to complete a BS degree (in FTM or FTD) and a TATM Master's degree in 5 to 5 1/2 years. Students in the ABM program can choose to pursue a non-thesis track in which they can potentially complete a Master of Textiles (MT) degree within 12 months after obtaining a Bachelor's (BS) degree in FTM or FTD. Alternatively, students can choose the thesis track in which they can potentially complete a Master of Science in Textiles (MS) degree within the18 months following obtaining a BS degree in FTM or FTD.

Admission Requirements

Students with a Bachelor of Science or a Bachelor of Arts degree may apply to either of the degree programs. Students apply with degrees in textiles, engineering, management, or design. The minimum acceptable overall Grade Point Average (GPA) is a 3.0 out of 4.0, based on most current U.S. universities. Students should have 20 credit hours in mathematics and natural sciences in their undergraduate degree. Degrees must be obtained from a four-year, accredited university. Graduate transfer credits can only be from other U.S. universities, and must be approved by the student's graduate committee. Certificates and diplomas are not recognized as undergraduate degrees.

Student Financial Support

Competitive financial aid in the form of assistantships may be available for full-time Master of Science students.

Other Relevant Information

The Department of Textile and Apparel, Technology and Management houses a Digital Design lab which specializes in 3D Body Scanning, Direct Digital Printing, Whole Body Knitted Garments, and Computer Aided Apparel and Fabric Design. Additionally, the department includes the Fashion Studio, The Textile Management Sciences Lab, Textile Design Studio, Braiding Lab, Three-Dimensional Weaving Lab, and an Advanced Testing Lab that will allow students to experience hands-on advanced textile technology and management.

Degrees

- Textiles (MR) (p. 864)
- Textiles (MS) (p. 866)
- Textile and Apparel Management (Minor) (p. 868)
- Consumer Textile Product Design and Development (Certificate) (p. 869)
- Textile Brand Management and Marketing (Certificate) (p. 869)

Faculty

Professor

Kristin A. Barletta

A. Blanton Godfrey

Maureen Grasso

Byoungho Ellie Jin

Traci A. M. Lamar

Karen K. Leonas

Pamela McCauley

Marguerite Moore

Abdel-fattah M. Seyam

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Nancy B. Powell

Gary W. Smith

Moon Won Suh

Sam C. Winchester

Assistant Professor

Kate Nartker

Janie F. Woodbridge

Research Assistant Professor

Shaghayegh Arangdad

Associate Professor

Kate Annett-Hitchcock

Helmut Hergeth

Kavita Mathur

Delisia Matthews

Lisa Parrillo-Chapman

Anne Porterfield

Lori F. Rothenberg

Minyoung Suh

Andre J. West

Adjunct Professor

Jaap Schut

Thomas Theyson

Adjunct Assistant Professor

Cassandra Kwon

Mohamad Midani

Adjunct Associate Professor

Michael Fralix

Genevieve Garland

John Meng

Mark A. Messura

Samuel B. Moore

Erin D. Parrish

Textiles (MR)

Master of Textiles Degree Requirements

- Required: 30 credit hours at 500 level or above
- Optional: maximum of 12 credit hours outside of department

Code	Title	Hours	Counts towards
Independent Study Courses			
TT 630	Independent Study in Textile Technology		
or TTM 632	Special Studies in Textile Product Development		
Optional: maximum of two credit hours seminar			
TT/TTM 601	Seminar		
Optional: online courses			
TT 500	Understanding the Textile Complex		
TT 503	Materials, Polymers, and Fibers used in Nonwovens		
TT 504	Introduction to Nonwovens Products and Processes		
TT 505	Advanced Nonwovens Processing		
TT 507	Nonwoven Characterization Methods		
TT 508	Nonwoven Product Development		
TT 520	Yarn Processing Dynamics		
TT 521	Filament Yarn Production Processing and Properties		
TT 549	Warp Knit Engineering and Structural Design		
TT 550	Production Mechanics and Properties of Woven Fabrics		
TT 551	Advanced Woven Fabric Design		
TT 553	Formation and Structure of Woven and Knitted Fabrics		
TT 591	Special Studies in Textile Technology		
TTM 501	Textile Enterprise Integration		
TTM 561	Strategic Technology Management in the Textile Complex		
TTM 573	Management of Textile Product Development		

TTM 581	Global Textile and Apparel Business Dynamics
TTM 582	Global Textile Brand Management and Marketing
TTM 583	Strategic Planning for Textile Firms
TTM 585	Market Research In Textiles
TTM 588	Global Perspectives in Textiles Supply Chain Management
TTM 591	Special Studies in Textile Technology Management
TT/TTM 601	Seminar
TT/TTM 630	Independent Study in Textile Technology

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Faculty

Professor

Kristin A. Barletta

A. Blanton Godfrey

Maureen Grasso

Byoungho Ellie Jin

Traci A. M. Lamar

Karen K. Leonas

Pamela McCauley

Marguerite Moore

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Erin D. Parrish

Textiles (MS)

Master of Science Degree Requirements

Code	Title	Hours	Counts towards
TT/TTM 601	**Seminar**	**1**	
Select six to ten credit hours of the following 600-level courses:		**6-10**	
TT/TTM 630	Independent Study in Textile Technology		
TT/TTM 693	Master's Supervised Research		
TT/TTM 695	Master's Thesis Research		
Select 15 credits in the "Specializations" listed below [1]		**15**	
TT/TTM 630	**Independent Study in Textile Technology**	**3**	
TT 676/TTM 632	**Special Projects Textile Technology**	**3**	
Total Hours		**30**	

[1] Course lists not exhaustive; can alternatively choose multiple specializations or specialization with minor. TT 591 Special Studies in Textile Technology/TTM 591 Special Studies in Textile Technology Management 1-4 credits recommended for all specializations.

Specializations

Code	Title	Hours	Counts towards
Textile Design & Fashion			
TT 551	Advanced Woven Fabric Design	3	
TT 570	Textile Digital Design and Technology	3	
TT 571	Professional Practices in Textile Design and Technology	3	
TTM 510	Apparel Technology Management	3	
TTM 515	Graduate Apparel Product Design	3	
TTM 517	Advanced Computer-Aided-Design for Fashion	3	
TTM 632/TT 676	Special Studies in Textile Product Development	1-6	

[1] Does not count toward 15 credit hour requirement

Code	Title	Hours	Counts towards
Branding and Retail			
TTM 561	Strategic Technology Management in the Textile Complex	3	
TTM 573	Management of Textile Product Development	3	
TTM 582	Global Textile Brand Management and Marketing	3	
TTM 583	Strategic Planning for Textile Firms	3	
TTM 585	Market Research In Textiles	3	
TTM 588	Global Perspectives in Textiles Supply Chain Management	3	

Code	Title	Hours	Counts towards
Textile Technology			
TT 504	Introduction to Nonwovens Products and Processes	3	

TT 520	Yarn Processing Dynamics	3	
TT 530	Textile Quality and Process Control	3	
TT 550	Production Mechanics and Properties of Woven Fabrics	3	

Code	Title	Hours	Counts towards
Textile Management			
TTM 530	Textile Quality and Process Control	3	
TTM 533	Lean Six Sigma Quality	3	
TTM 535	Research Methods and Management	3	
TTM 561	Strategic Technology Management in the Textile Complex	3	
TTM 581	Global Textile and Apparel Business Dynamics	3	
TTM 583	Strategic Planning for Textile Firms	3	

Accelerated Bachelor's/Master's Degree Requirements

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Textile and Apparel Management (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Samuel B. Moore

Erin D. Parrish

Consumer Textile Product Design and Development (Certificate)

The Graduate Certificate in Consumer Textile Product Design and Development (GCCTPDD), offered by the Department of Textile and Apparel, Technology and Management, will provide NC State graduate students the opportunity to develop recognized academic credentials in Consumer Textile Product Design and Development in addition to their major area of graduate study. Also it will offer non-degree graduate-level students the opportunity to develop recognized advanced expertise in Consumer Textile Product Design and Development.

Applications

New applicants to the university must submit a Program Application, a resume identifying educational preparation and work experiences, and official transcripts of all undergraduate and graduate course work. You must apply online through the Graduate School application portal. Prior to completing the first course after being accepted into the program, students prepare and submit two copies of a contract using the Certificate Contract Application. The contract includes a statement of career goals, a rationale for completing the certificate program, and a timeline for certificate completion. Students can always elect to review their application with the Certificate Coordinator prior to contract preparation.

Academic Requirements

Applicants must meet one of the three following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in an NC State University graduate program;
- Have a Master's degree.

Plan Requirements

Code	Title	Hours	Counts towards
TTM 580	**Consumer Perspectives in Fashion**	**3**	
TTM 585	**Market Research In Textiles**	**3**	
Select three of the following:		**9**	
TTM 515	Graduate Apparel Product Design		
TTM 517	Advanced Computer-Aided-Design for Fashion		
TT 570	Textile Digital Design and Technology		
TT 571	Professional Practices in Textile Design and Technology		
TTM 510	Apparel Technology Management		
TTM 632	Special Studies in Textile Product Development		
Total Hours		**15**	

Textile Brand Management and Marketing (Certificate)

The Graduate Certificate Program in Textile Brand Management and Marketing provides graduate students with the opportunity to develop academic credentials in branding fundamentals and theories for a globalized industry and market research while complementing this knowledge with topics of strategic management, product development, supply chain management and technology management. The program also provides non-degree graduate-level students with the opportunity to

develop recognized advanced expertise in Textile Brand Management and Marketing.

Admission

Applications must meet one of the following three requirements:

- Be a graduate of an accredited four-year college or university and have a grade point average of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in an NC State University graduate program; or
- Have a Master's degree.

Applicants who do not meet the GPA requirements may be admitted professionally based on past work experience as a professional in textiles or a textile related field. Supporting documentation of professional experience in textile should be submitted for provisional admission. Students who are admitted provisionally must earn at least a "B" average in the first three courses of the certificate program in order to obtain full admission into the certificate program.

Requirements

A minimum of 15 credit hours is required to complete the certificate program and student must have a minimum 3.0 grade point average on all certificate course work. Transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the student begins course work for the Certificate

Plan Requirements

Code	Title	Hours	Counts towards
Required Core Courses			
TTM 582	Global Textile Brand Management and Marketing	3	
Select three of the following:		9	
TTM 561	Strategic Technology Management in the Textile Complex		
TTM 573	Management of Textile Product Development		
TTM 583	Strategic Planning for Textile Firms		
TTM 588	Global Perspectives in Textiles Supply Chain Management		
TTM 630	Independent Study in Textile Technology Management		
Total Hours		**12**	

Graduate Certificate - Wilson College of Textiles

Certificates

- Consumer Textile Product Design and Development (Certificate) (p. 869)
- Nonwoven Science and Technology (Certificate) (p. 871)
- Textile Brand Management and Marketing (Certificate) (p. 869)
- Textile Supply Chain Management (Certificate) (p. 858)

Consumer Textile Product Design and Development (Certificate)

The Graduate Certificate in Consumer Textile Product Design and Development (GCCTPDD), offered by the Department of Textile and Apparel, Technology and Management, will provide NC State graduate students the opportunity to develop recognized academic credentials in Consumer Textile Product Design and Development in addition to their major area of graduate study. Also it will offer non-degree graduate-level students the opportunity to develop recognized advanced expertise in Consumer Textile Product Design and Development.

Applications

New applicants to the university must submit a Program Application, a resume identifying educational preparation and work experiences, and official transcripts of all undergraduate and graduate course work. You must apply online through the Graduate School application portal. Prior to completing the first course after being accepted into the program, students prepare and submit two copies of a contract using the Certificate Contract Application. The contract includes a statement of career goals, a rationale for completing the certificate program, and a timeline for certificate completion. Students can always elect to review their application with the Certificate Coordinator prior to contract preparation.

Academic Requirements

Applicants must meet one of the three following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in an NC State University graduate program;
- Have a Master's degree.

Plan Requirements

Code	Title	Hours	Counts towards
TTM 580	**Consumer Perspectives in Fashion**	**3**	
TTM 585	**Market Research In Textiles**	**3**	
Select three of the following:		**9**	
TTM 515	Graduate Apparel Product Design		

TTM 517	Advanced Computer-Aided-Design for Fashion	
TT 570	Textile Digital Design and Technology	
TT 571	Professional Practices in Textile Design and Technology	
TTM 510	Apparel Technology Management	
TTM 632	Special Studies in Textile Product Development	
Total Hours		**15**

Nonwoven Science and Technology (Certificate)

The Nonwovens Institute offers a University Graduate Certificate in Nonwovens Science and Engineering through the Wilson College of Textiles. The program is available to students currently enrolled in a graduate degree program at NC State as well as non-degree seeking graduate level students. Any student seeking a certificate in Nonwovens Science and Engineering must be a graduate of an accredited four-year college or university. The goal of this certificate is to provide recognized academic credentials in Nonwoven Science and Engineering.

Eligibility

Applicants must apply through the Graduate School for the Graduate Certificate in Nonwoven Science and Engineering. Applicants submit a resume identifying educational preparation and work experiences and official transcripts of all undergraduate and graduate coursework.

Applicants must meet one of the three following requirements:

1. Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study
2. Be a degree student in good standing in an NC State University graduate program
3. Have a master's degree

The certificate must be completed within four (4) calendar years from the date the student starts the first course. Awarding of the certificate requires a minimum GPA of 3.0 or better in all of the required courses.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
NW/TT 504	Introduction to Nonwovens Products and Processes		
NW/TT 503	Materials, Polymers, and Fibers used in Nonwovens		
or TMS 762	Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures		
NW/TT 505	Advanced Nonwovens Processing		
NW/TT 507	Nonwoven Characterization Methods		
NW/TT 508	Nonwoven Product Development		
Total Hours		**15**	

Textile Brand Management and Marketing (Certificate)

The Graduate Certificate Program in Textile Brand Management and Marketing provides graduate students with the opportunity to develop academic credentials in branding fundamentals and theories for a globalized industry and market research while complementing this knowledge with topics of strategic management, product development, supply chain management and technology management. The program also provides non-degree graduate-level students with the opportunity to develop recognized advanced expertise in Textile Brand Management and Marketing.

Admission

Applications must meet one of the following three requirements:

- Be a graduate of an accredited four-year college or university and have a grade point average of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in an NC State University graduate program; or
- Have a Master's degree.

Applicants who do not meet the GPA requirements may be admitted professionally based on past work experience as a professional in textiles or a textile related field. Supporting documentation of professional experience in textile should be submitted for provisional admission. Students who are admitted provisionally must earn at least a "B" average in the first three courses of the certificate program in order to obtain full admission into the certificate program.

Requirements

A minimum of 15 credit hours is required to complete the certificate program and student must have a minimum 3.0 grade point average on all certificate course work. Transfer credit from other universities is not allowed. All work must be completed in four (4) calendar years, beginning from the time the student begins course work for the Certificate

Plan Requirements

Code	Title	Hours	Counts towards
Required Core Courses			
TTM 582	Global Textile Brand Management and Marketing	3	
Select three of the following:		9	
TTM 561	Strategic Technology Management in the Textile Complex		
TTM 573	Management of Textile Product Development		
TTM 583	Strategic Planning for Textile Firms		
TTM 588	Global Perspectives in Textiles Supply Chain Management		
TTM 630	Independent Study in Textile Technology Management		
Total Hours		**12**	

Textile Supply Chain Management (Certificate)

The Graduate Certificate Program in Textile Supply Chain Management provides NC State graduate students the opportunity to develop recognized academic credentials in this concentration in addition to their major area of graduate study. The Certificate also provides non-degree graduate-level students the opportunity to develop recognized advanced expertise in Textile Supply Chain Management.

Admission

Applicants must meet one of the 3 following requirements:

- Be a graduate of an accredited four-year college or university, and have a GPA of at least 3.0 on a 4-point scale in their last 60 credit hours of undergraduate study;
- Be a degree student in good standing in a NC State University graduate program; and
- Have a Master’s degree.

Provisional Admission

Applicants who do not meet the GPA requirements may be admitted provisionally based on past work experiences as a professional in textiles or a textile related field. Supporting documentation of professional experience in textiles should be submitted for provisional admission. Students who are admitted provisionally must earn at least a “B” average in the first three courses of the certificate program in order obtain full admission into the certificate program.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
TTM 501	Textile Enterprise Integration	3	
TTM 761	Supply Chain Management and Information Technology	3	
TE 533	Lean Six Sigma Quality [1]	3	
or TE 540	Textile Information Systems Design		
Select two of the following advanced courses:		6	
TTM 530	Textile Quality and Process Control		
TTM 583	Strategic Planning for Textile Firms		
TTM 588	Global Perspectives in Textiles Supply Chain Management (USA)		
Total Hours		**15**	

[1] either or both - spare will be used as an "advanced course"

Interdisciplinary

Programs

- Bioinformatics (p. 873)
- Biomathematics (p. 715)
- Financial Mathematics (p. 878)
- Fisheries, Wildlife, and Conservation Biology (p. 882)
- Functional Genomics (p. 886)
- Genetics (p. 896)
- Interdisciplinary Minors (p. 917)
- Operations Research (p. 908)

Degree Programs

Master's (MR)

- Bioinformatics (MR) (p. 875)
- Financial Mathematics (MR) (p. 879)
- Fisheries, Wildlife, and Conservation Biology (MR) (p. 883)
- Functional Genomics (MR) (p. 888)
- Genetics (MR) (p. 898)
- Operations Research (MR) (p. 910)

Master of Science (MS)

- Fisheries, Wildlife, and Conservation Biology (MS) (p. 884)
- Functional Genomics (MS) (p. 890)
- Genetics (MS) (p. 901)
- Operations Research (MS) (p. 912)

Doctor of Philosophy (PhD)

- Bioinformatics (PhD) (p. 876)
- Fisheries, Wildlife, and Conservation Biology (PhD) (p. 885)
- Functional Genomics (PhD) (p. 892)
- Genetics (PhD) (p. 904)
- Operations Research (PhD) (p. 914)

Minors

- Bioinformatics (Minor) (http://catalog.ncsu.edu/graduate/interdisciplinary/bioinformatics/bioinformatics-minor/)
- Biotechnology (Minor) (p. 917)
- Ecology (Minor) (p. 918)
- Environmental Remote Sensing & Image Analysis (Minor) (p. 918)
- Food Safety (Minor) (p. 919)
- Functional Genomics (Minor) (p. 894)
- Genetics (Minor) (p. 906)
- Geographic Information Systems (Minor) (p. 920)
- Interdisciplinary (Minor) (p. 921)
- Operations Research (Minor) (p. 916)
- Teamwork in Interdisciplinary Biomedical Research (Minor) (p. 921)
- Water Resources (Minor) (p. 922)
- Women's, Gender, and Sexuality Studies (Minor) (p. 923)

Bioinformatics

NC State offers two closely linked interdepartmental graduate programs in Genomic Sciences. All students pursuing degrees in either Bioinformatics and Functional Genomics will take a shared core set of courses that promote breadth of knowledge and encourage interdisciplinary collaboration.

Functional Genomics students focus on laboratory research requiring the collection and interpretation of massive data sets that enhance our knowledge of organismal biology, gene expression, protein and nucleic acid structure and function, and genetic and environmental interactions. Bioinformatics students develop skills to manage and analyze these large and complex “omics” data sets. These two groups of students will be prepared to work seamlessly as parts of teams addressing fundamentally important problems in areas including the biomedical sciences, plant and animal breeding, evolutionary biology, ecology, and toxicology.

Unique and exceptional resources include the Bioinformatics Research Center and the Genome Research Laboratory.

Admission Requirements

Students applying to either the Master’s or PhD program in Bioinformatics are evaluated on their background in three key areas: mathematics and statistics; genetics and biological sciences; and computer science. Students should have completed at least two semesters of calculus, and additional courses in mathematics and statistics are preferred. Evidence of basic computer programming skills is required. A course in genetics is strongly encouraged. Previous research experience is a significant advantage.

Master's Degree Requirements

Students take a 15-credit core curriculum shared by all students in the Bioinformatics and Functional Genomics degree programs, followed by additional bioinformatics and elective courses. The Master's of Bioinformatics requires a minimum of 33 credit hours. No thesis is required.

Doctoral Degree Requirements

Students take a 15-credit core curriculum shared by all students in the Bioinformatics and Functional Genomics degree programs, followed by additional bioinformatics and elective courses. The Ph.D. in Bioinformatics requires a total of 72 credits, and all students participate in a journal club, monthly seminar series and research ethics training. All PhD students assemble advisory committees including faculty from both Bioinformatics and Functional Genomics to promote effective interdisciplinary research and collaboration, and many students have co-advisors representing different fields.

Student Financial Support

Fellowships are available through the program, and students may also be supported by research and training grants awarded to our faculty members.

Degrees

- Bioinformatics (MR) (p. 875)
- Bioinformatics (PhD) (p. 876)

Faculty

Full Professors

Jose Miguel Alonso

Christopher M. Ashwell

David M. Bird

Donald L. Bitzer

Russell J. Borski

Matthew Breen

Dennis T. Brown

Ignazio Carbone

Marie Davidian

Jon Doyle

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Denis Fourches

Amanda Marie Hulse

Jicai Jiang

David Rasmussen

Christina Zakas

Practice/Research/Teaching Professors

Patricia A. Estes

Jane L. Lubischer

Emeritus Faculty

William Reid Atchley

Wendy F. Boss

Rebecca S. Boston

James W. Brown

Vincent L. C. Chiang

Eugene Eisen

Todd Robert Klaenhammer

Wayne Tompkins

Anastasios A. Tsiatis

Paul L. Wollenzien

Bioinformatics (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Genomics Sciences Core Courses		**12**	
ST 590	Special Topics (Bioinformatics I)		
GN 735	Functional Genomics		
PP 610	Special Topics (Genomic Sciences Journal Club) [1]		
GN 701	Molecular Genetics		
or BCH 703	Macromolecular Synthesis and Regulation		
GN 850	Professionalism and Ethics		
Bioinformatics Core Courses		**12**	
ST 590	Special Topics (Bioinformatics II)		
CSC 530	Computational Methods for Molecular Biology		
ST 512	Statistical Methods For Researchers II		
ST 610	Topics in Stat		
Elective Courses		**9**	
"Elective Courses" will be determined in conjunction with the academic committee			
Total Hours		**33**	

[1] PP 610 Genomic Sciences Journal Club is to be completed twice.

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Anastasios A. Tsiatis

Paul L. Wollenzien

Bioinformatics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Genomics Sciences Core Courses		**12**	
ST 590	Special Topics (Bioinformatics I)		
GN 735	Functional Genomics		
PP 810	Special Topics (Genomic Sciences Journal Club) [1]		
GN 701	Molecular Genetics		
or BCH 703	Macromolecular Synthesis and Regulation		
GN 850	Professionalism and Ethics		
Bioinformatics Core Courses		**12**	
ST 590	Special Topics (Bioinformatics II)		
CSC 530	Computational Methods for Molecular Biology		
ST 512	Statistical Methods For Researchers II		
ST 810	Advanced Topics in Statistics (Bioinformatics Consulting)		
Bioinformatics PhD Courses		**8**	
PP 810	Special Topics (Genomic Sciences Journal Club) [1]		

ST 501	Fundamentals of Statistical Inference I	
ST 502	Fundamentals of Statistical Inference II	
Elective Courses		**9**
"Elective Courses" will be determined in conjunction with the academic committee		
Doctoral Research Courses		**32**
"Doctoral Research Courses" will be determined in conjunction with the academic committee		
Total Hours		**73**

[1] PP 810 Genomic Sciences Journal Club should be repeated four times (twice for "Genomic Sciences Core Courses" and twice for "Bioinformatics PhD Courses").

Faculty

Full Professors

Jose Miguel Alonso

Christopher M. Ashwell

David M. Bird

Donald L. Bitzer

Russell J. Borski

Matthew Breen

Dennis T. Brown

Ignazio Carbone

Marie Davidian

Jon Doyle

Robert Graham Franks

Sujit K. Ghosh

Amy Michele Grunden

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Spencer V. Muse

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Barbara Sherry

Seth M. Sullivant

Jeffrey L. Thorne

Jung-Ying Tzeng

Mladen Alan Vouk

Ross W. Whetten

Fred Andrew Wright

Qiuyun Xiang

Zhaobang Zeng

Daowen Zhang

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Nicolas Buchler

Gavin Clay Conant

Michael B. Goshe

Steffen Heber

Slavko Komarnytsky

David S. Lalush

Terri A. Long

Arnab Maity

Flora Meilleur

Dahlia M. Nielsen

Jonathan W. Olson

Xinxia Peng

David Michael Reif

Michael L. Sikes

Charles Eugene Smith

Lori June Unruh Snyder

Yihui Zhou

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Hamid Ashrafi

Benjamin J. Callahan

Rafael Felipe Guerrero Farias

Denis Fourches

Amanda Marie Hulse

Jicai Jiang

David Rasmussen

Christina Zakas

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Jane L. Lubischer

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Eugene Eisen

Todd Robert Klaenhammer

Wayne Tompkins

Anastasios A. Tsiatis

Paul L. Wollenzien

Financial Mathematics

The Departments of Mathematics, Agricultural and Resource Economics, Economics, Industrial and Systems Engineering, Statistics and Business management offer a program leading to the degree of Master of Financial Mathematics. Students choose core courses and electives to suit their individual needs and interests.

Admissions Requirements

Applicants for admission should have an undergraduate degree that would preferably include courses in advanced calculus, linear algebra, probability and statistics**.**

Master of Financial Mathematics Requirements

In addition to course requirements (six core courses and five electives), the Master of Financial Mathematics degree requires completion of a 1-credit internship or research project.

Student Financial Support

Some funding is available through a limited number of fellowships. Consideration for the support is automatic. There are no teaching assistantships or research assistantships for this Professional Science Masters.

Degrees

- Financial Mathematics (MR) (p. 879)

Full Professors

David Dickey

Paul Fackler

Sujit Ghosh

Kazufumi Ito

Negash Medhin

Tao Pang

Tom Vukina

Mark Walker

Richard Warr

Associate Professors

Min Kang

Denis Pelletier

Charlie Smith

Assistant Professors

Ilze Kalnina

Yerkin Kitapbayev

Practice/Research/Teaching Professors

Wei Chen

Richard Ellson

Jeffrey High

Ram Valluru

Emeritus Faculty

Richard Bernhard

Peter Bloomfield

Jeffrey Scroggs

John Seater

Jim Wilson

Financial Mathematics (MR)

Master of Financial Mathematics Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**26**	
FIM/ECG/MA/ MBA 528			
ST 501	Fundamentals of Statistical Inference I		
ISE 711	Capital Investment Economic Analysis		
FIM 500	Career Development for Quants		
MA 547	Stochastic Calculus for Finance		
ST 502	Fundamentals of Statistical Inference II		
MA/FIM 548	Monte Carlo Methods for Financial Math		
FIM 601	Seminar in Financial Mathematics [1]		
ECG 766	Computational Methods in Economics and Finance		
Summer Internship/Project Course		**1**	
Select one summer semester requirement of the following:			
FIM 650	Internship in Financial Mathematics		
FIM 675	Project in Financial Mathematics		
Elective Courses		**9**	
See "Elective Courses" listed below			
Total Hours		**36**	

[1] Students need to take FIM 601 (1 credit) in their second and third semesters for a total of 2 credits

Elective Courses

Code	Title	Hours	Counts towards
Select at least three courses listed below:		**9**	
Risk Management Track			
FIM/MA 549	Financial Risk Analysis	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
MBA 518	Enterprise Risk Management	3	
MBA 521	Advanced Corporate Finance	3	
Data Science for Finance Track			
ISE 519	Database Applications in Industrial and Systems Engineering	3	
ST 503	Fundamentals of Linear Models and Regression	3	
ST 516	Experimental Statistics For Engineers II	3	
ST 540	Applied Bayesian Analysis	3	
ST 590	Special Topics (Applied Time Series)	1-6	
ST 562	Data Mining with SAS Enterprise Miner	3	
ST 555	Statistical Programming I	3	

Portfolio Management Track		
OR/MA 504	Introduction to Mathematical Programming	3
OR/ISE 505	Linear Programming	3
OR 506	Algorithmic Methods in Nonlinear Programming	3
MBA 523	Investment Theory and Practice	3
MBA 524	Equity Valuation	3
MA 531	Dynamic Systems and Multivariable Control I	3
ISE 519	Database Applications in Industrial and Systems Engineering	3
Actuarial Science Track		
ECG 701	Microeconomics I	3
ECG 702	Microeconomics II	3
ECG/ST 750	Introduction to Econometric Methods	3
ECG/ST 751	Econometric Methods	3
ECG/ST 752	Time Series Econometrics	3
ECG/ST 753	Microeconometrics	3
MA/ST 747	Probability and Stochastic Processes II	3
MBA 518	Enterprise Risk Management	3
PhD Preparation Track		
OR/ISE 505	Linear Programming	3
ECG/ST 751	Econometric Methods	3
ECG/ST 752	Time Series Econometrics	3
MA 523	Linear Transformations and Matrix Theory	3
MA 540	Uncertainty Quantification for Physical and Biological Models	3
MA/ST 546	Probability and Stochastic Processes I	3
ST 730		3
ST 740	Bayesian Inference and Analysis	3
MA 791	Special Topics In Real Analysis (Functional Analysis)	1-6
Other		
CSC 505	Design and Analysis Of Algorithms	3
CSC 522	Automated Learning and Data Analysis	3
CSC 540	Database Management concepts and Systems	3
CSC 541	Advanced Data Structures	3
CSC/MA 580	Numerical Analysis I	3
CSC/MA 583	Introduction to Parallel Computing	3
ISE 712	Bayesian Decision Analysis For Engineers and Managers	3
MBA 515	Enterprise Resource Planning Systems	3
MBA 526	International Finance	3
MA 515	Analysis I	3
MA 520	Linear Algebra	3
MA 532	Ordinary Differential Equations I	3
MA 534	Introduction To Partial Differential Equations	3
MA 544	Computer Experiments In Mathematical Probability	3
MA 555	Introduction to Manifold Theory	3
MA/BMA 573	Mathematical Modeling of Physical and Biological Processes I	3

MA/BMA 574	Mathematical Modeling of Physical and Biological Processes II	3
MA 584	Numerical Solution of Partial Differential Equations--Finite Difference Methods	3
MA 587	Numerical Solution of Partial Differential Equations--Finite Element Method	3
MA 715	Measure Theory and Integration	3
MA 723	Theory of Matrices and Applications	3
MA/ST 746	Introduction To Stochastic Processes	3
MA/ST 748	Stochastic Differential Equations	3
OR/ISE 501	Introduction to Operations Research	3
OR/MA 504	Introduction to Mathematical Programming	3
OR/E/MA 531	Dynamic Systems and Multivariable Control I	3
OR/MA 719	Vector Space Methods in System Optimization	3
OR/ISE 772	Stochastic Simulation Design and Analysis	3
OR/BMA/MA/ST 773	Stochastic Modeling	3
ST 505	Applied Nonparametric Statistics	3
ST 512	Statistical Methods For Researchers II	3
ST 556	Statistical Programming II	3
ST 563	Introduction to Statistical Learning	3

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

Full Professors

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Fisheries, Wildlife, and Conservation Biology

The degrees are offered through the Fisheries, Wildlife, and Conservation Biology program, an intercollegiate program administered by the Colleges of Natural Resources, Agriculture and Life Sciences, and Veterinary Medicine. Students are affiliated with the department of their major professor. The degrees emphasize habitat assessment, population biology, human dimensions, environmental policy, animal health, and sustainable management of fish and wildlife species.

Admissions Requirements

Application for admission is made directly to the Fisheries, Wildlife, and Conservation Biology program. Minimum requirements include an undergraduate grade point average of 3.0 in an appropriate biological discipline. Completion of the Graduate Record Examination (GRE) is optional, depending on the requirements of individual faculty. Admission is competitive and is contingent on the willingness of a member of the faculty to serve as the major professor. Exceptions to minimum requirements may be made for students with special backgrounds.

Master's Degree Requirements

The M.S. degree program requires a minimum of 30 credit hours, including 1-2 hours of seminar and no more than six hours of research. A research-based thesis is required, as is a minor (usually 9-10 hours). The Master of Fisheries, Wildlife, and Conservation Biology degree requires a minimum of 36 credits (including 4-6 hours of special problems and 1-2 hours of seminars), a professional paper, a committee and final exam. For either degree, further requirements may be imposed by the advisory committee and/or department.

Doctoral Degree Requirements

The Ph.D. program requires 36 to 54 credits of course work beyond the Master's degree, including two seminars and an ethics course, and a dissertation. Exceptionally well-prepared students may petition to have their degree objective changed to Ph.D. before completing the Master's degree.

Student Financial Support

Graduate research and teaching assistantships are offered for qualified students through participating departments. Commitments for assistantships are normally made at the time of admission to graduate study.

Other Relevant Information

Research near campus is facilitated by excellent field, laboratory and computer resources. Off-campus research is conducted at the Pamlico Aquaculture Field Laboratory, research and extension centers in eastern and western NC, The Center for Marine Sciences and Technology in Morehead City, Bull Neck Swamp, Hill Forest, and at facilities of state and federal agencies and private organizations.

Degrees

- Fisheries, Wildlife, and Conservation Biology (MR) (p. 883)
- Fisheries, Wildlife, and Conservation Biology (MS) (p. 884)
- Fisheries, Wildlife, and Conservation Biology (PhD) (p. 885)

Faculty

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Jesse Robert Fischer

Roland Wesley Kays

Lara B. Pacifici

Martha Burford Reiskind

Kara Kristina Walker

Fisheries, Wildlife, and Conservation Biology (MR)

Degree Requirements

The Master of Fisheries, Wildlife, and Conservation Biology degree requires a minimum of 36 credits (including 4-6 hours of special problems and 1-2 hours of seminars), a professional paper, a committee and final exam.

Code	Title	Hours	Counts towards
Required Courses		**6-8**	
AEC 502	Introduction to Biological Research		
FW 693	Master's Supervised Research		
Additional Courses		**28-30**	
"Additional Courses" are approved in conjunction with the academic committee to meet 36 total hours			
Total Hours		**36**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master’s (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor’s and Master’s degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master’s degree in the same field within 12 months of completing the Bachelor’s degree, or obtain a thesis-based Master’s degree in the same field within 18 months of completing the Bachelor’s degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Fisheries, Wildlife, and Conservation Biology (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**8**	
AEC 502	Introduction to Biological Research		
FW 695	Master's Thesis Research		
Minor Courses		**9**	
Select nine credit hours of credits for a required minor determined in conjunction with the academic committee			
Additional Courses		**13**	
"Additional Courses" are approved in conjunction with the academic committee to meet 30 total hours			
Total Hours		**30**	

Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

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Fisheries, Wildlife, and Conservation Biology (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**5-13**	
AEC 502	Introduction to Biological Research		
FW 730	Ethics in Fisheries and Wildlife Sciences		

FW 893/895	Doctoral Supervised Research	
Additional Courses		**59-67**
"Additional Courses" are approved in conjunction with the academic committee to meet 72 total hours		
Total Hours		**72**

Faculty

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Functional Genomics

NC State offers two closely linked interdepartmental graduate programs in Genomic Sciences. All students pursuing degrees in either Bioinformatics and Functional Genomics will take a shared core set of courses that promote breadth of knowledge and encourage interdisciplinary collaboration.

Functional Genomics students focus on laboratory research requiring the collection and interpretation of massive data sets that enhance our knowledge of organismal biology, gene expression, protein and nucleic

acid structure and function, and genetic and environmental interactions. Bioinformatics students develop skills to manage and analyze these large and complex “omics” data sets. These two groups of students will be prepared to work seamlessly as parts of teams addressing fundamentally important problems in areas including the biomedical sciences, plant and animal breeding, evolutionary biology, ecology, and toxicology.

Unique and exceptional resources include the Bioinformatics Research Center and the Genome Research Laboratory.

Admission Requirements

Students applying to either the Master’s or PhD program in Functional Genomics should have an undergraduate major in the biological or physical sciences, including courses in genetics, biochemistry, and calculus. Previous research experience is a significant advantage.

Master's Degree Requirements

Students take a 15-credit core curriculum shared by all students in the Bioinformatics and Functional Genomics degree programs, followed by additional genomics and elective courses. The non-thesis Master of Functional Genomics requires a minimum of 30 credit hours, while the Master of Science in Functional Genomics requires 36 credit hours and a thesis.

Doctoral Degree Requirements

Students take a 15-credit core curriculum shared by all students in the Bioinformatics and Functional Genomics degree programs, followed by additional genomics and elective courses. The Ph.D. in Functional Genomics requires a total of 72 credits, and all students participate in a journal club, monthly seminar series and research ethics training. All PhD students assemble advisory committees including faculty from both Bioinformatics and Functional Genomics to promote effective interdisciplinary research and collaboration, and many students have co-advisors representing different fields.

Student Financial Support

Fellowships are available through the program, and students may also be supported by research and training grants awarded to our faculty members.

Degrees

- Functional Genomics (MR) (p. 888)
- Functional Genomics (MS) (p. 890)
- Functional Genomics (PhD) (p. 892)
- Functional Genomics (Minor) (p. 894)

Faculty

Full Professors

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Prema Arasu

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Matthew Breen

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James W. Brown

Ignazio Carbone

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Ralph E. Dewey

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Troy Ghashghaei

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Major M. Goodman

Amy Michele Grunden

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Todd Robert Klaenhammer

David H. Ley

James W. Moyer

Paul E. Orndorff

Ron Ross Sederoff

Wayne Tompkins

Paul L Wollenzien

Adjunct Faculty

Robert R. Anholt

Trudy F. MacKay

Functional Genomics (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Genomic Sciences Core Courses		**12**	
ST 590	Special Topics (Intro Bioinformatics)		

GN 735	Functional Genomics	
GN 701	Molecular Genetics	
or BCH 703	Macromolecular Synthesis and Regulation	
PP 810/610	Special Topics (Genomics Journal Club)	
GN 850	Professionalism and Ethics	
Functional Genomics Core Courses		**18**
ST 511	Statistical Methods For Researchers I	
GN 702	Cellular and Developmental Genetics	
or BCH 705	Molecular Biology Of the Cell	
GN 703	Population and Quantitative Genetics	
or BCH 701	Macromolecular Structure	
Students will select an additional nine credit hours of Functional Genomics Category I Electives in conjunction with the academic committee [1]		
Total Hours		**30**

[1] Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 30 credit requirement.

Faculty

Full Professors

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Prema Arasu

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Manuel Kleiner

Kurt Marsden

Santosh Kumar Mishra

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Christina Zakas

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Adjunct Faculty

Robert R. Anholt

Trudy F. MacKay

Functional Genomics (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Genomic Sciences Core Courses		**12**	
ST 590	Special Topics (Intro Bioinformatics)		
GN 735	Functional Genomics		
GN 701	Molecular Genetics		
or BCH 703	Macromolecular Synthesis and Regulation		
PP 810/610	Special Topics (Genomics Journal Club)		
GN 850	Professionalism and Ethics		

Functional Genomics Core Courses		**18**
ST 511	Statistical Methods For Researchers I	
GN 702	Cellular and Developmental Genetics	
or BCH 705	Molecular Biology Of the Cell	
GN 703	Population and Quantitative Genetics	
or BCH 701	Macromolecular Structure	
Students will select an additional nine credit hours of Functional Genomics Category I Electives in conjunction with the academic committee [1]		
Thesis Research Courses		**6**
"Thesis Research Courses" will be determined in conjunction with the academic committee		
Total Hours		**36**

[1] Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 36 credit requirement.

Faculty

Full Professors

Kenneth B. Adler

Jose Miguel Alonso

Prema Arasu

Christopher M. Ashwell

David M. Bird

Russell J. Borski

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Edward Bealmear Breitschwerdt

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Functional Genomics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Genomic Sciences Core		**12**	
ST 590	Special Topics (Intro Bioinformatics)		
GN 735	Functional Genomics		
GN 701	Molecular Genetics		
or BCH 703	Macromolecular Synthesis and Regulation		
PP 810	Special Topics (Genomics Journal Club) [1]		
GN 850	Professionalism and Ethics		
Functional Genomics Core		**11**	
ST 511	Statistical Methods For Researchers I		
GN 702	Cellular and Developmental Genetics		
or BCH 705	Molecular Biology Of the Cell		

GN 703/ BCH 701	Population and Quantitative Genetics	
PP 810	Special Topics (Genomics Journal Club) [1]	
Elective Courses		**9**
Functional Genomics Category I Electives will be determined in conjunction with the academic committee [2]		
Research and Additional Electives		**40**
"Research and Additional Electives" will be determined in conjunction with the academic committee		
Total Hours		**72**

1 PP 810 Special Topics: Genomics Journal Club must be taken multiple times to meet the required core hours.

2 Functional Genomic Category I Electives cannot be chosen from ST 590, CSC 530, ST 512, ST 501, or ST 502. However, these courses can be taken as additional electives beyond the minimum 36 credit requirement.

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Functional Genomics (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Genetics

The Genetics Graduate Program is a University wide program. Current faculty are in 14 Departments and four Colleges. The Genetics Program provides a well-balanced program of graduate course work and research training. The faculty conducts basic research in all areas of genetics, including molecular, cellular and developmental genetics; behavioral genetics, biomedical genetics, evolutionary, population and quantitative genetics, statistical genetics, and bioinformatics. Faculty research utilizes both traditional model organisms (fruit flies, mice and Arabidopsis) and non-traditional systems (cats, cockroaches, dairy cattle, dogs, maize, pigs, pine trees and more). Interdisciplinary research is encouraged.

Admission Requirements

Applicants may come from a number of undergraduate programs that include biological, agricultural, physical and mathematical science training. All applications are screened by an admissions committee, and the best qualified applicants will be accepted up to the number of spaces that are available for new students. The program uses the requirements set by the Graduate School to evaluate applications (GRE, unofficial transcripts from each previously attended college or university, three letters of recommendation, personal statement, and proof of English proficiency for non-US citizens). Competitive applicants will include research and other relevant experience as well as their interest and fit for the program in their personal statement.

Master's Degree Requirements

The M.S. degree requires a minimum of 30 credit hours, of which 14 hours are core course requirements, three hours are additional elective graduate courses with substantial genetics content, and three hours are other elective graduate courses. M.S. students majoring in Genetics are required to complete dissertation research with three credit hours of Master's Supervised Research, six credits of Master's Thesis Research, one credit of Master’s Thesis Prep, and one credit of Master’s Examination. M.S. students are also required to teach one semester of undergraduate courses and may enroll in three credits of Master’s Supervised Teaching. 12 hours of required courses are required for Genetics minors. The Master's of Genetics requires a minimum of 31 credit hours, of which 17 hours are core course requirements, six hours are additional elective genetics courses and eight hours are elective graduate courses.

Doctoral Degree Requirements

A total of 18 hours of seven core courses and 12 hours of elective graduate courses, nine of which have substantial genetics content, is required of all majors. Ph.D. students majoring in Genetics are required to complete dissertation research with three credit hours of Doctoral Supervised Research and a combination of Doctoral Dissertation Research, Doctoral Preliminary Examination, and Doctoral Dissertation Prep to total 39 hours. Students are also required to and teach two semesters of undergraduate courses and may enroll in six credits of Doctoral Supervised Teaching to be used toward the remaining 39 credit hours. 12 hours of required courses are required for Genetics minors.

Student Financial Support

Genetics graduate students are supported on Research and Teaching Assistantships (RAs and TAs). Specific pay varies depending on the assistantship, and students are paid bi-weekly. More information will be provided at the time of acceptance into the program.

Other Relevant Information

All M. S. and Ph. D. students rotate through three laboratories during their first semester. At the end of the semester, they choose a laboratory for their research activities consistent with their interests and available research projects. Provisions are available for a co-major and collaborative research in more than one laboratory.

Degrees

- Genetics (MR) (p. 898)
- Genetics (MS) (p. 901)
- Genetics (PhD) (p. 904)
- Genetics (Minor) (p. 906)

Faculty

Full Professors

Jose Miguel Alonso

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Earl A. Wernsman

Adjunct professors

Robert R .Anholt

Trudy F. MacKay

Alison Anne Motsinger-Reif

Nadia Singh

Genetics (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**17**	
GN 701	Molecular Genetics		
GN 702	Cellular and Developmental Genetics		
GN 703	Population and Quantitative Genetics		
GN 850	Professionalism and Ethics		
ST 511	Statistical Methods For Researchers I		
BCH 451	Principles of Biochemistry		
Elective Courses [1, 2]		**6**	

See "Elective Courses" listed below	
Other Electives	**8**
"Other Electives" are approved in conjunction with the academic committee	
Total Hours	**31**

1 Only three hours of these courses may be counted toward the primary elective requirement.

2 Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.

Elective Courses

Code	Title	Hours	Counts towards
Select a minimum of three courses below:		**6**	
GN 713	Quantitative Genetics and Breeding	3	
GN 721	Genetic Data Analysis	3	
GN 725	Forest Genetics	3	
GN 735	Functional Genomics	3	
GN 740	Evolutionary Genetics	3	
GN 745	Quantitative Genetics In Plant Breeding	1	
GN 750	Developmental Genetics	3	
GN 755	Population Genetics	3	
GN 756	Computational Molecular Evolution	3	
GN 757	Quantitative Genetics Theory and Methods	3	
GN 758	Microbial Genetics & Genomics	3	
GN 761	Advanced Molecular Biology Of the Cell	3	
GN 768	Nucleic Acids: Structure and Function	3	
GN 810	Special Topics in Genetics	1-6	
GN 820	Special Problems	1-6	
ST 590	Special Topics (Bioinformatics I)	1-6	
ST 590	Special Topics (Bioinformatics II)	1-6	
PB 780	Plant Molecular Biology	3	
PB 824	Topical Problems (Topics in Plant Molecular Genetics)	1-4	
BCH 701	Macromolecular Structure	3	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 815	Advanced Special Topics	1-6	

Faculty

Full Professors

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Genetics (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**14**	
GN 701	Molecular Genetics		
GN 702	Cellular and Developmental Genetics		
GN 703	Population and Quantitative Genetics		
GN 810	Special Topics in Genetics (Journal Club)		
GN 850	Professionalism and Ethics		
ST 511	Statistical Methods For Researchers I		
Teaching Requirement		**3**	
GN 685	Master's Supervised Teaching		
Elective Course [1, 2]		**3**	
See "Elective Courses" listed below			
Other Elective		**3**	
"Other Elective" is determined in conjunction with the academic committee			
Research Course		**9**	
GN 695	Master's Thesis Research		
Total Hours		**32**	

1 Only three hours of these courses may be counted toward the primary elective requirement.

2 Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.

Elective Courses

Code	Title	Hours	Counts towards
Select a minimum of two courses below:		**6**	
GN 713	Quantitative Genetics and Breeding	3	
GN 721	Genetic Data Analysis	3	
GN 725	Forest Genetics	3	
GN 735	Functional Genomics	3	
GN 740	Evolutionary Genetics	3	
GN 745	Quantitative Genetics In Plant Breeding	1	
GN 750	Developmental Genetics	3	
GN 755	Population Genetics	3	
GN 756	Computational Molecular Evolution	3	
GN 757	Quantitative Genetics Theory and Methods	3	

GN 758	Microbial Genetics & Genomics	3
GN 761	Advanced Molecular Biology Of the Cell	3
GN 768	Nucleic Acids: Structure and Function	3
GN 810	Special Topics in Genetics	1-6
GN 820	Special Problems	1-6
ST 590	Special Topics (Bioinformatics I)	1-6
ST 590	Special Topics (Bioinformatics II)	1-6
PB 780	Plant Molecular Biology	3
PB 824	Topical Problems (Topics in Plant Molecular Genetics)	1-4
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Genetics (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Core Courses		**18**	
GN 701	Molecular Genetics		
GN 702	Cellular and Developmental Genetics		
GN 703	Population and Quantitative Genetics		
GN 810	Special Topics in Genetics (Journal Club) [1]		
GN 820	Special Problems		
GN 850	Professionalism and Ethics		
ST 511	Statistical Methods For Researchers I		
Teaching Course		**6**	
GN 885	Doctoral Supervised Teaching		
Elective Courses [2, 3]		**9**	
See "Elective Courses" listed below			
Other Elective		**3**	
"Other Elective" is determined in conjunction with the academic committee			
Research Course		**36**	
GN 895	Doctoral Dissertation Research		
Total Hours		**72**	

1. GN 810 Special Topics in Genetics is to be repeated twice to meet the 2 credit hour requirement.
2. Only three hours of these courses may be counted toward the primary elective requirement.
3. Other courses that do not appear on this list may be counted if they have substantial genetics content. Please consult with the Director of Graduate Programs if you would like to count a course as an elective that is not on this list.

Elective Courses

Code	Title	Hours	Counts towards
Select at least three courses below:			
GN 713	Quantitative Genetics and Breeding	3	
GN 721	Genetic Data Analysis	3	
GN 725	Forest Genetics	3	
GN 735	Functional Genomics	3	
GN 740	Evolutionary Genetics	3	
GN 745	Quantitative Genetics In Plant Breeding	1	
GN 750	Developmental Genetics	3	
GN 755	Population Genetics	3	
GN 756	Computational Molecular Evolution	3	
GN 757	Quantitative Genetics Theory and Methods	3	
GN 758	Microbial Genetics & Genomics	3	
GN 761	Advanced Molecular Biology Of the Cell	3	
GN 768	Nucleic Acids: Structure and Function	3	
GN 810	Special Topics in Genetics	1-6	
GN 820	Special Problems (Professional Development)	1-6	
ST 590	Special Topics (Bioinformatics I)	1-6	
ST 590	Special Topics (Bioinformatics II)	1-6	
PB 780	Plant Molecular Biology	3	
PB 824	Topical Problems (Topics in Plant Molecular Genetics)	1-4	
BCH 701	Macromolecular Structure	3	
BIT 510	Core Technologies in Molecular and Cellular Biology	4	
BIT 815	Advanced Special Topics	1-6	

Faculty

Full Professors

Jose Miguel Alonso

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Christine Veronica Hawkes

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Kathryn Montgome Meurs

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Jean B. Ristaino

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Rafael Felipe Guerro Farias

Amanda Marie Hulse

Albert Jun Qi Keung

Manuel Kleiner

Caroline Laplante

Wusheng Liu

Anna Michelle Locke

Elizabeth Lucas

Kurt Marsden

Santosh Kumar Mishra

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Charles William Stuber

Earl A. Wernsman

Adjunct professors

Robert R .Anholt

Trudy F. MacKay

Alison Anne Motsinger-Reif

Nadia Singh

Genetics (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
GN 701	Molecular Genetics		
GN 702	Cellular and Developmental Genetics		
GN 703	Population and Quantitative Genetics		
ST 511	Statistical Methods For Researchers I		
Total Hours		**12**	

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Operations Research

Operations Research (OR) is a graduate program of an interdisciplinary nature, governed by an administrative board and the program committee, and administered through the office of the program director.

Admission Requirements

Applications are accepted from undergraduate majors in all technical disciplines. Applicants should have had at least four math courses beyond calculus (e.g., courses in differential equations, linear algebra, probability and statistics, and mathematical analysis). Knowledge of a computer programming language is recommended, but not required. GRE scores are required of all new applicants.

Master's Degree Requirements

The Master of Operations Research degree is a terminal graduate degree for students who seek careers as OR practitioners in either the private or public sector. The M.S. degree is designed to prepare students for careers in research and development.

Doctoral Degree Requirements

The Ph.D. degree is intended for students to be research scientists in industry or teachers and researchers in academia. This degree requires a minimum of 72 hours of graduate credit beyond the bachelor's degree, including coursework in major and minor areas of concentration together with credit for doctoral research and dissertation preparation. A departmental written qualifying examination is required. For students who have completed a Master's degree from another institution prior to joining the Ph.D. program, a minimum of 54 hours of additional graduate credit are required.

Student Financial Support

Both teaching and research assistantships are available to qualified applicants. Award priority is given to Ph.D. then M.S. applicants. Outstanding students who are U.S. citizens and who shall be enrolled in the NC State Graduate School for the first time are eligible for the Engineering Dean's Graduate Fellowship Program.

Degrees

- Operations Research (MR) (p. 910)
- Operations Research (MS) (p. 912)
- Operations Research (PhD) (p. 914)
- Operations Research (Minor) (p. 916)

John W. Baugh

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Ting Yu

Operations Research (MR)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**15**	
Requirement A Courses			
OR 601	Seminar in Operations Research		
Requirement B Courses			
Select one of the following courses:			
OR 505	Linear Programming		
OR 506	Algorithmic Methods in Nonlinear Programming		
OR 709	Dynamic Programming		
Requirement C Courses			
Select four of the following courses:			
OR 501	Introduction to Operations Research		
OR 504	Introduction to Mathematical Programming [1]		
or OR 505	Linear Programming		
CSC 505	Design and Analysis Of Algorithms		
OR 506	Algorithmic Methods in Nonlinear Programming [1]		
ST 516	Experimental Statistics For Engineers II		
OR 531	Dynamic Systems and Multivariable Control I		
OR 537	Computer Methods and Applications		
MA/ST 546	Probability and Stochastic Processes I		
OR 560	Stochastic Models in Industrial Engineering		
OR 562	Simulation Modeling		
OR 706	Nonlinear Programming		
OR 708	Integer Programming		
OR 709	Dynamic Programming [1]		
MA/ST 747	Probability and Stochastic Processes II		
OR 760	Applied Stochastic Models in Industrial Engineering		
OR 761	Queues and Stochastic Service Systems		
OR 762	Computer Simulation Techniques		
OR 772	Stochastic Simulation Design and Analysis		
Elective Courses		**15**	
"Elective Courses" that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee [2]			
Total Hours		**30**	

1. OR 505, OR 506, and OR 709 cannot be double counted toward "Requirement C" courses if already used toward "Requirement B" courses.
2. "Elective Courses" cannot be double counted if already used to fulfill requirements "A-C" courses

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Operations Research (MS)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**19**	
Requirement A Courses			
OR 601	Seminar in Operations Research		
OR 695	Master's Thesis Research		
Requirement B Courses			
Select one of the following courses:			
OR 505	Linear Programming		
OR 506	Algorithmic Methods in Nonlinear Programming		
OR 709	Dynamic Programming		
Requirement C Courses			
Select four of the following courses:			
OR 501	Introduction to Operations Research		
OR 504	Introduction to Mathematical Programming [1]		
or OR 505	Linear Programming		
CSC 505	Design and Analysis Of Algorithms		
OR 506	Algorithmic Methods in Nonlinear Programming [1]		
ST 516	Experimental Statistics For Engineers II		
OR 531	Dynamic Systems and Multivariable Control I		
OR 537	Computer Methods and Applications		
MA/ST 546	Probability and Stochastic Processes I		
OR 560	Stochastic Models in Industrial Engineering		
OR 562	Simulation Modeling		
OR 706	Nonlinear Programming		
OR 708	Integer Programming		
OR 709	Dynamic Programming [1]		
MA/ST 747	Probability and Stochastic Processes II		
OR 760	Applied Stochastic Models in Industrial Engineering		
OR 761	Queues and Stochastic Service Systems		
OR 762	Computer Simulation Techniques		
OR 772	Stochastic Simulation Design and Analysis		
Elective Courses		**12**	
"Elective Courses" that will be applied to reach 30 credit hours will be determined in conjunction with the academic committee [2]			
Total Hours		**31**	

1. OR 505, OR 506, and OR 709 cannot be double counted toward "Requirement C" courses if already used toward "Requirement B" courses.
2. "Elective Courses" cannot be double counted if already used to fulfill requirements "A-C" courses

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Operations Research (PhD)

Degree Requirements

Code	Title	Hours	Counts towards
Required Courses		**17**	
Requirement A Course			
OR 801	Seminar in Operations Research		
Requirement B Course			
Select one of the following:			
OR 505	Linear Programming		
OR 506	Algorithmic Methods in Nonlinear Programming		
OR 709	Dynamic Programming		
Requirement C Courses			
Select four of the following:			
OR 501	Introduction to Operations Research		
OR 504	Introduction to Mathematical Programming [1]		
or OR 505	Linear Programming		
CSC 505	Design and Analysis Of Algorithms		
OR 506	Algorithmic Methods in Nonlinear Programming [1]		
ST 516	Experimental Statistics For Engineers II		
OR 531	Dynamic Systems and Multivariable Control I		
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MA/ST 546	Probability and Stochastic Processes I		
OR 560	Stochastic Models in Industrial Engineering		
OR 562	Simulation Modeling		
OR 706	Nonlinear Programming		
OR 708	Integer Programming		
OR 709	Dynamic Programming [1]		
MA/ST 747	Probability and Stochastic Processes II		
OR 760	Applied Stochastic Models in Industrial Engineering		
OR 761	Queues and Stochastic Service Systems		
OR 762	Computer Simulation Techniques		
OR 772	Stochastic Simulation Design and Analysis		
Elective Courses		**6-55**	
"Elective Courses" are determined in conjunction with the academic committee to meet the 72 total credit hours			
Total Hours		**23-72**	

1. OR 505, OR 506, and OR 709 cannot be double counted toward "Requirement C" courses if already used toward "Requirement B" courses.
2. "Elective Courses" cannot be double counted if already used to fulfill requirements "A-C" courses

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Operations Research (Minor)

Plan Requirements

Master of Science Requirements

Code	Title	Hours	Counts towards
Required Courses		**9**	
Select nine hours of coursework approved in conjunction with the academic committee			
Total Hours		**9**	

Doctoral Requirements

Code	Title	Hours	Counts towards
Required Courses		**12**	
Select twelve hours of coursework approved in conjunction with the academic committee			
Total Hours		**12**	

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Interdisciplinary Minors

Minors

- Bioinformatics (Minor) (http://catalog.ncsu.edu/graduate/interdisciplinary/bioinformatics/bioinformatics-minor/)
- Biotechnology (Minor) (p. 917)
- Ecology (Minor) (p. 918)
- Environmental Remote Sensing & Image Analysis (Minor) (p. 918)
- Food Safety (Minor) (p. 919)
- Functional Genomics (Minor) (p. 894)
- Genetics (Minor) (p. 906)
- Geographic Information Systems (Minor) (p. 920)
- Interdisciplinary (Minor) (p. 921)
- Operations Research (Minor) (p. 916)
- Teamwork in Interdisciplinary Biomedical Research (Minor) (p. 921)
- Water Resources (Minor) (p. 922)
- Women's, Gender, and Sexuality Studies (Minor) (p. 923)

Biotechnology (Minor)

M.S. and Ph.D. minors in biotechnology are available to students who successfully complete at least eight credit hours in selected laboratory core courses and conduct their graduate thesis research in an area of biotechnology. At least one member of the student's thesis committee must be a member of the Biotechnology faculty. Research in biotechnology is focused in three main areas: recombinant DNA technology, bioprocessing/bioanalytical techniques, and in vitro culture techniques. The multidisciplinary nature of biotechnology means that a wide range of research topics and techniques are applicable.

Students wishing to pursue graduate studies leading to either a M.S. or Ph.D. minor in biotechnology must enroll and conduct their research in a participating department. For specific information about enrollment requirements, contact the participating departments of interest to you directly.

Plan Requirements

Code	Title	Hours	Counts towards
Required Course		**4**	
BIT 510	Core Technologies in Molecular and Cellular Biology [1]		
Elective Courses		**4**	
Select two of the following:			
BIT 564	Protein Purification		
BIT 565	Real-time PCR Techniques		
BIT 566	Animal Cell Culture Techniques		
BIT 567	PCR and DNA Fingerprinting		
BIT 568	Genome Mapping		
BIT 571	RNA Interference and Model Organisms		
BIT 573	Protein Interactions		
BIT 574	Plant Genetic Engineering		
BIT 577	Metagenomics		
BIT 578	Mapping the Brain		
BIT 579	High-Throughput Discovery		
BIT 580	Yeast Metabolic Engineering		
BIT 581	Plant Transformation		

BIT 815	Advanced Special Topics (Professional Development)	
BIT 815	Advanced Special Topics (Research Ethics)	
BIT 815	Advanced Special Topics (Capstone Biotechnology)	
Additional courses will be determined in conjunction with the academic committee		
Total Hours		**8**

[1] Students may place out of BIT 510 if they have had either a similar course as an undergraduate or if they have substantial practical experience and conceptual knowledge of the material covered. The approval to place out of BIT 510 is made by the Academic Advisor of the Biotechnology Program, in conjunction with consultation with the student's thesis advisor. If placing out of BIT 510, the student will instead take one additional 2-credit BIT lab course for a total of three (and will complete the minor requirements with 6 credits of coursework rather than 8).

Full Professor

Robert M. Kelly

Associate Professors

Lauren V. Schnabel

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Nathan Crook

Glenn P. Cruse

Mary Elting

Manuel Kleiner

Sharonda Latrice Johnson LeBlanc

Kelly Meiklejohn

Santosh Mishra

Benjamin J. Reading

Jack Wang

Xiaoqiu Wang

Stefanie Chen

Carlos C. Goller

Melissa Srougi

Ecology (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**4**	
AEC 502	Introduction to Biological Research		
AEC 503	Foundations of Ecology		
Elective Courses		**5-8**	
Select five credit hours (MS) or eight credit hours (PhD) in conjunction with the academic committee [1]			
Total Hours		**9-12**	

[1] Courses must be outside the student's major discipline

Additional Requirements

- Must maintain an average of 3.0 (B) for courses taken to complete the Ecology minor.
- A graduate faculty member who conducts research in Ecology must serve on the students graduate advisory committee. This committee member should be chosen in consultation with the Ecology minor DGP.*
- The student must obtain approval from the Ecology minor DGP to enroll in the minor.
- If the student is doing a non-thesis degree program, the student must obtain approval from the Ecology minor DGP for their minor program of study (Graduate Student Plan of Work).

Environmental Remote Sensing & Image Analysis (Minor)

This minor provides graduate students the opportunity to develop a recognized academic credential in remote sensing and image analysis in conjunction with their major program of graduate study. Twelve credit hours, 6 credit hours of required courses and 6 credit hours of elective courses, is required to complete the minor.

Other Requirements

A GIST graduate faculty member must be on the student’s graduate committee. A list of currently approved faculty members can be provided to students upon request. If no graduate committee is required by the student’s program, the student must obtain approval of his or her minor program. Students enrolled in Option B Masters programs are not eligible to declare a minor. Certificate coursework and Minor coursework must be completely independent.

Plan Requirements

Code	Title	Hours	Counts towards
Core Courses		**6**	
GIS 512	Introduction to Environmental Remote Sensing		
or GIS 712	Environmental Earth Observation and Remote Sensing		
ST 533	Applied Spatial Statistics		
or ECE 514	Random Processes		
Elective Courses		**6**	
Select two courses of the following:[1]			
GIS 512	Introduction to Environmental Remote Sensing		
GIS 520	Spatial Problem Solving		
GIS 530	Spatial Data Foundations		
GIS 595	Special Topics in Geospatial Information Science		
GIS 584	Mapping and Analysis Using UAS		
GIS 712	Environmental Earth Observation and Remote Sensing		
SSC 545	Remote Sensing Applications in Soil Science and Agriculture		
BAE 536	GIS Applications in Precision Agriculture		
MEA 511	Introduction to Meteorological Remote Sensing		
ST 533	Applied Spatial Statistics		
ECE 751	Detection and Estimation Theory		
ECE 759	Pattern Recognition and Machine Learning Methods		
Total Hours		**12**	

[1] Additional courses may be decided in conjunction with the academic committee.

Faculty

Full Professors

Ross Meentemeyer

Helena Mitasova

Stacy Nelson

Gary Roberson

Sandra Yuter

Associate Professors

Mirela Tulbure

Jeffrey White

Assistant Professors

Josh Gray

Practice/Research/Teaching Professors

Perver Baran

Stacy Supak

Emeritus Faculty

Hugh Devine

Siamak Khorram

Food Safety (Minor)

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
FSA 520	Pre-Harvest Food Safety		
FSA 530	Post-Harvest Food Safety		
FSA 540	Food Safety and Public Health		
FSA 580	Professional Development and Ethics in Food Safety		
Total Hours		**0**	

Geographic Information Systems (Minor)

The Geographic Information Systems (GIS) minor provides an academic credential for students who want to develop some GIS application skills while pursuing a graduate degree in another discipline. It is designed for students who wish to master the basics of GIS analysis and to develop more advanced skills in a particular application area.

Other Requirements: A GIST graduate faculty member must be on the student's graduate committee. A list of currently approved faculty members can be provided to students upon request. If no graduate committee is required by the student's program, the student must obtain approval of his or her minor program. Students enrolled in Option B Masters programs are not eligible to declare a minor. Certificate coursework and Minor coursework must be completely independent.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**6**	
GIS 510	Fundamentals of Geospatial Information Science and Technology		
GIS 520	Spatial Problem Solving		
or GIS 582	Geospatial Modeling		
Elective Courses		**3**	
See "Elective Courses" listed below			
Total Hours		**9**	

Elective Courses

Code	Title	Hours	Counts towards
Select three credits from the following courses: *		**3**	
GIS 512	Introduction to Environmental Remote Sensing	3	
GIS 515	Cartographic Design	2	
GIS/LAR 517	GIS Applications in Landscape Architecture and Environmental Planning	3	
GIS 520	Spatial Problem Solving	3	
GIS 521	Surface Water Hydrology with GIS	3	
GIS 530	Spatial Data Foundations	3	
GIS 535	Web and Mobile GIS Protocols	3	
GIS 595	Special Topics in Geospatial Information Science	1-6	
GIS/MEA 582	Geospatial Modeling	3	
GIS 584	Mapping and Analysis Using UAS	3	
GIS 609	Geospatial Forum	1	
GIS 610	Special Topics in Geospatial Information Science	1-6	
GIS 711	Geospatial Data Management	3	
GIS 712	Environmental Earth Observation and Remote Sensing	3	
GIS 713	Geospatial Data Mining	3	
GIS 714	Geospatial Computation and Simulation	3	
GIS 715	Geovisualization	3	
SSC 540	Geographic Information Systems (GIS) in Soil Science and Agriculture	3	
SSC 545	Remote Sensing Applications in Soil Science and Agriculture	3	
BAE 535	Precision Agriculture Technology	3	
BAE 536	GIS Applications in Precision Agriculture	1	
MEA 511	Introduction to Meteorological Remote Sensing	3	
HI 535	Spatial History	3	
ST 533	Applied Spatial Statistics	3	

* Other courses not listed can be approved as an elective upon consultation with an advisor.

Faculty

Full Professors

Yu-Fai Leung

Ross Meentemeyer

Helena Mitasova

Stacy Nelson

Gary Roberson

Sandra Yuter

Associate Professors

Mirela Tulbure

Raju Vatsavai

Jeffrey White

Assistant Professors

Josh Gray

Jelena Vukomanovic

Practice/Research/Teaching Professors

Perver Baran

Eric Money

Stacy Supak

Laura Tateosian

Vaishnavi Thakar

Emeritus Faculty

Heather Cheshire

Hugh Devine

Siamak Khorram

Interdisciplinary (Minor)

Plan Requirements

The interdisciplinary minor requires two or more areas of coursework to be represented with a faculty member representing one of the areas of coursework. Students who are interested in an interdisciplinary minor should contact their Directors of Graduate Programs for more information.

Teamwork in Interdisciplinary Biomedical Research (Minor)

The objective of the proposed minor in Teamwork in Interdisciplinary Biomedical Research (TIBR) is to provide interdisciplinary team science training and professional development for future leaders in academia, government, and industry who will subsequently make groundbreaking molecular medicine discoveries, embrace and apply the concepts of rigor and reproducibility and responsible conduct of science, and participate in translating new discoveries into clinical applications for the benefit of human health.

Minor Admissions Requirements

1. They are pursuing a PhD degree and are in their 1st, 2nd, or 3rd year of graduate study.
2. Intended students are active in biomedical sciences, such as those pursuing degrees in Biomedical Engineering (BME) and Comparative Biological Sciences (CBS), among others.

Minimum Grade Requirements for the Minor Courses

A grade of S (pass/fail courses) or B (graded courses) must be achieved in each course counted towards the minor.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses		**13**	
CBS 660	Fundamentals of Comparative Molecular Medicine		
CBS 661	Principles of Collaboration and Team Science		
CBS 563	Leadership in Interdisciplinary Biomedical Sciences		
Young Scholars Program Courses *			
CBS 886	Interdisciplinary Research Team Mentoring		
Total Hours		**13**	

* Participation in Young Scholars Program (YSP) or equivalent (3 credits), taken two times, CBS 886 is suggested.

Faculty

Minor Directors

Deborah Acker

Matthew Fisher

Additional Minor Leadership Team Members

April Kedrowicz

Jorge Piedrahita

Joshua Pierce

Water Resources (Minor)

The interdisciplinary, interdepartmental graduate minor in water resources is designed for students majoring in the many disciplines of natural resources, science, engineering, technology, and social sciences that are relevant to water resources. The minor exposes students to water resources courses and faculty members within and outside their major fields of study.

The graduate minor in water resources (WR) requires successful completion ("B-" or better in each individual WR course, GPA of 3.0 or better across all WR courses counted toward the minor) of at least 9 credits of WR courses chosen from the lists below. At least 3 of the 9 credits (for M.S. students) or 6 of the 9 credits (for Ph.D. students) must be from outside the student's major department. For M.S. students (not Ph.D. students), up to 3 credits at the 400-level may be included if these credits are from outside the student's major department. For students earning an M.S. before enrolling in a Ph.D. program, courses taken to satisfy a WR minor in the M.S. program can not be counted toward a WR minor in the subsequent Ph.D. program. However, WR courses taken during the M.S. program may count toward a WR minor in the subsequent Ph.D. program if the M.S. program did not include a WR minor.

Plan Requirements

- At least 3 (MS) or 6 (PhD) credit hours must be from outside major

Code	Title	Hours	Counts towards
Required Courses		**9**	
See "Focus Areas" listed below			
Total Hours		**9**	

Minor Focus Areas

Hydrological and Meteorological Aspects of Water Resources

Code	Title	Hours	Counts towards
Select three of the following courses:		**9**	
BAE 502	Instrumentation for Hydrologic Applications	3	
BAE 576	Watershed Monitoring and Assessment	3	
BAE 577	Wetlands Design and Restoration	3	
BAE 581	Open Channel Hydraulics for Natural Systems	3	
BAE 583	Stream Corridor 3 Es: Ecohydraulics, Engineering and Ethics	3	
BAE 584	Introduction to Fluvial Geomorphology	3	
BAE/SSC 771	Theory Of Drainage--Saturated Flow	3	
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 607	Water Resource and Environmental Engineering Seminar	1	
FOR 420/520/ NR 420/520	Watershed and Wetlands Hydrology	4	
MEA 455	Micrometeorology	3	
MEA 481	Geomorphology: Earth's Dynamic Surface	3	
MEA 485	Introduction to Hydrogeology	3	
MEA 585	Physical Hydrogeology	3	
MEA 715	Dynamics of Mesoscale Precipitation System	3	
SSC 470/570	Wetland Soils	3	
SSC 511	Soil Physics	4	

Water Quality Aspects of Water Resources

Code	Title	Hours	Counts towards
Select three of the following courses:		**9**	
BAE 473	Introduction to Hydrologic and Water Quality Modeling	3	
BAE/SSC 573	Introduction to Hydrologic and Water Quality Modeling	3	
MEA 760	Biogeochemistry	3	
MEA 763	Isotope Geochemistry	3	
MEA 785	Chemical Hydrogeology	3	
SSC 442	Soil and Environmental Biogeochemistry	3	
SSC 521	Soil Chemistry	3	

Biological and Ecological Aspects of Water Resources

Code	Title	Hours	Counts towards
Select three of the following courses:		**9**	

BAE 472/572	Irrigation and Drainage	3
BAE 574	DRAINMOD: Theory and Application	3
BAE 575	Design of Structural Stormwater Best Management Practices	3
BAE 578	Agricultural Waste Management	3
BAE 580	Introduction to Land and Water Engineering	3
CE 484	Water Supply and Waste Water Systems	3
CE 571	Physical Principles of Environmental Engineering	3
CE 574	Chemical Principles of Environmental Engineering	3
CHE 575	Advances in Pollution Prevention: Environmental Management for the Future	3
CS/HS/SSC/TOX 725	Pesticide Chemistry	1
CS/HS/SSC/TOX 727	Pesticide Behavior and Fate In the Environment	2
NR 521	Wetland Science and Management	3
SSC 562	Environmental Applications Of Soil Science	3

Legal, Institutional, and Economic Aspects of Water Resources

Code	Title	Hours	Counts towards
Select three of the following courses:		**9**	
ECG 515	Environmental and Resource Policy	3	
ET 460	Practice of Environmental Technology	3	
LAR 430	Site Planning	3	
NR 460	Renewable Natural Resource Management and Policy	3	
NR 571	Current Issues in Natural Resource Policy	3	
NR 484	Environmental Impact Assessment	4	
PA 550	Environmental Policy	3	

Women's, Gender, and Sexuality Studies (Minor)

The minor provides graduate students in the humanities, social sciences and sciences with the theories and methodologies to study women and gender relations. The minor is intended to support and further students' research in their own field.

- Nine hours of graduate credit are required with a B or better in each course.
- No more than three hours of coursework may overlap between the major department coursework requirement and the Women's, Gender and Sexuality Studies minor. Students may choose from the courses listed on the website and/or a list of approved special topics courses.
- Because the Minor is an interdisciplinary one, at least one of the courses needs to be in a field different from that of the graduate program in which the student is enrolled.
- All courses must be taught by the Women's, Gender and Sexuality Studies Affiliated Faculty.
- An Affiliated Faculty member (not in the field of the degree graduate program) must sit on the master's or dissertation committee.

Plan Requirements

Code	Title	Hours	Counts towards
Required Courses			
Select nine credit hours of the following: [1]		9	
WGS/ANT 544	Cross-Cultural Perspectives on Women		
WGS/ECD 540	Gender Issues In Counseling		
WGS/HI 547	Women in America: From Contact to the Civil War		
WGS/HI 548	American Women in the Twentieth Century		
WGS/REL 573	Religion, Gender, and Reproductive Technologies		
WGS/PSY 706	Psychology of Gender		

WGS/SOC 737	Sociology Of Gender	
SOC 739	Social Psychology Of Inequality	
Total Hours		**9**

[1] Special topics courses in a variety of disciplines are offered each semester and may be taken with the approval of the Women's and Gender Studies Director.

Faculty

Associate professor

Karey Harwood

NC State Graduate Handbook

The Graduate Handbook provides an overview of Graduate School functions and resources, as well as the rules, regulations, and procedures administered by the Graduate School.

It is the responsibility of all graduate students to know and understand their degree requirements. Students are responsible for the fulfillment of those requirements.

NC State also lists official policies, regulations and rules (PRRs) on the university's PRR website (https://policies.ncsu.edu/). Links to pertinent PRRs are found in the Graduate Handbook sections that contain PRR information.

Graduate Administration

Applications and Admissions

Graduate Degrees: Policies and Procedures

Financial Assistance

Codes of Conduct

1.1 Graduate School Responsibilities

The mission of the Graduate School is to serve as a catalyst for excellence in graduate education at NC State through:

- promoting the highest quality education for students and postdoctoral scholars, including outstanding academic experiences, opportunities to engage in cutting-edge research, and professional development that prepares students and postdoctoral scholars for success in their fields;
- advancing the diversity of graduate education at NC State and of the professoriate nationwide through recruitment, retention, and support of underrepresented minority groups;
- fostering an environment in which graduate faculty can reach their potential as teachers, researchers, and mentors to graduate students;
- encouraging research and graduate programs that address the critical issues that challenge our state, our nation, and our world;
- achieving recognition of NC State as a model for leadership and innovation in graduate education in North America.

1.2 Graduate Student Responsibilities

By accepting admission to NC State University, graduate students indicate that they are ultimately responsible for adhering to the policies and procedures that govern their education at the university. That responsibility requires that all graduate students know where to find

the rules and regulations of the Graduate School and any additional requirements of their specific programs.

Students are expected to adhere to either the requirements in place at the time they matriculate at NC State or any subsequent versions of the requirements approved during their continuous enrollment. Students must use an entire set of requirements; they may not piece together a set of requirements from various versions. If a student is readmitted, they must use the requirements in place at that time or any subsequent versions, but they cannot choose requirements from their previous enrolled status.

The Graduate Handbook defines the **minimum** requirements of the Graduate School and describes procedures that must be followed. Individual program requirements may be found in the Graduate Catalog (p. 66) and should be available through the department office or its website.

All students must also abide by standards of conduct established by NC State. The Graduate Handbook section on Codes of Conduct provides web links to Policies, Procedures, and Rules (https://policies.ncsu.edu/).

1.3 Graduate Faculty

Faculty participation in graduate education is a critical element of university life. The engagement with students as advisors and mentors plays a critical role in developing future researchers and instilling in them the qualities required for degree completion. Membership in the graduate faculty is a privilege.

A. Graduate Faculty

- All full-time tenured and tenure-earning faculty will be granted Graduate Faculty status based on a majority vote of a department's graduate faculty at the time of hire. Emeritus faculty and those on phased retirement retain their Graduate Faculty status.
- Full-time faculty in non-tenure positions (e.g., clinical, extension, practicum, research, teaching, professor of practice, and federal contractual employees, such as USDA, DOI, U.S. Forest Service) may be granted Graduate Faculty status upon a majority vote of the graduate faculty in the department/program in which they are employed.
- Graduate faculty at another university who are in a joint department/program with one at NC State are considered graduate faculty at NC State.
- If a chair of an advisory committee leaves NC State for another position, s/he may continue as chair for one more year. After that period, s/he can only co-chair with another member of the Graduate Faculty.

B. Affiliate Graduate Faculty

- All non-tenure-line faculty who are on temporary appointments or are not paid by the university and who are expected to serve on master's or doctoral advisory committees and/or teach graduate courses will be granted Affiliate Graduate Faculty status by departmental vote (see Section E). Such faculty include those who are adjunct, visiting, and interinstitutional (Duke and UNC-Chapel Hill). Faculty at other universities or others seeking Affiliate Graduate Faculty status require a majority vote of approval by the graduate faculty in the department/program they are to be affiliated with.

C. External Members and Technical Consultants

- Affiliate Graduate Faculty status is not required for the participation of external members of committees and technical consultants (see 3.2 Advisory Committees (p. 936) for definitions and credentials of these roles).

D. Responsibilities of Graduate Faculty

The responsibilities associated with membership in the Graduate Faculty include:

- teaching courses at the graduate level (i.e., courses at the 500-900 levels)
- participating as a chair, co-chair, or member of master's and doctoral advisory committees
- serving as Graduate School Representative when requested by the Graduate School

The roles associated with membership in the Graduate Affiliate Faculty include:

- teaching courses at the graduate level (i.e., courses at the 500-900 levels)
- participating as a member of advisory committees

E. Application for Graduate Faculty and Affiliate Graduate Faculty Status

- Because new tenured or tenure-track faculty become members of the graduate faculty at the time of hire, there is no separate application process for membership in the Graduate Faculty. To ensure that Graduate Faculty status is granted, the Graduate Faculty Nomination form must be submitted to the Graduate School for processing.
- Before members of the Graduate Faculty can serve in another department/program, however, their membership generally should be voted on by the Graduate Faculty in that department/program. It may be approved by the given program's DGP in consultation with the program's faculty.
- For non-tenure-line faculty seeking Affiliate Graduate Faculty status, the department head or DGP forwards the Graduate Nomination Form along with a current CV to the Graduate School. As part of that process, members of the Graduate Faculty of the appropriate department/program vote and those results must be included on the Affiliate Graduate Faculty Nomination Form.

F. Requirements to Teach Graduate Courses at NC State

The Request to Teach Graduate Courses form should be completed and submitted to the Graduate School for instructors who are not members of the Graduate Faculty. For instructors who do not have a terminal degree in the discipline in which they will be teaching, a thorough justification outlining their alternative credentials is required for approval by the Graduate School.

G. Removal of Graduate Faculty/Affiliate Graduate Faculty Members

- Members of the Graduate Faculty of a specific department or program may initiate removal of a current Graduate Faculty member

based on the failure to carry out the responsibilities (see Section D) or for other good cause. The department must vote on this recommendation and consult with the college dean, and if it is decided that a faculty member should be removed from the Graduate Faculty, the head or DGP (in the case of non-departmental programs) makes this recommendation in the form of a memo to the Dean of the Graduate School. The memo should include the vote of the members of the department's/program's Graduate Faculty. The dean of the Graduate School is then authorized to remove the person from the Graduate Faculty.

- If the member has Graduate Faculty status in more than one department/program, the status would be maintained unless all relevant entities voted to remove the member.

1.4 Directors of Graduate Programs

Appointment Process

Each department offering graduate study is required to appoint a Director of Graduate Programs (https://grad.ncsu.edu/about/people/dgp/) (DGP) from among its Graduate Faculty. The Department Head, or Dean in the case of interdisciplinary programs, submits this designation in writing to the Graduate Dean. The Director of Graduate Programs plays a critical role in overseeing graduate education at the department/program level in variety of arenas as outlined below.

Responsibilities

Communication

- Handles all correspondence between the graduate program and the Graduate School and between the Graduate School and the program;
- Transmits information from the Graduate School to students;
- Submits requests for scheduling preliminary and final oral examinations and graduation checkouts;
- Communicates with the Office of International Services (OIS) and serves as a critical academic authority for matters that may affect students' visa status.

Oversight

- Conducts the daily administration of departmental graduate programs;
- Recommends admission or denial of graduate applicants;
- Approves students' Graduate Plans of Work after approval by the student's Graduate Committee; submits plans to the Graduate School.

Interaction with Students

- Plays a lead role in recruiting graduate students;
- Conducts orientation of new graduate students;
- Serves as the program's point of contact for concerns that students may have;
- Assigns graduate students to assistantships.

Advising

- Advises students requesting admission to the graduate program;
- Serves as temporary advisor to new graduate students, providing them information and advice including but not limited to course selection and scheduling, faculty interests, procedural matters, and University resources;
- Monitors graduate students' progress and graduation credits;
- Assists new students in selecting a major advisor;
- Advises students on various aspects of program progress and completion as needed.

Fellowship Support

- Assists the Graduate School in developing fellowship proposals, including recruitment of graduate faculty to draft proposals and participate in proposed fellowship project;
- Nominates eligible students for individual fellowships and transmits their applications to the Graduate School;
- Supports the Graduate School in managing fellowship awards to the program's graduate students.

Program Development and Evaluation

- Initiates program-related proposals to the Administrative Board of the Graduate School (Admin Board), either informally through contact with Graduate Deans or formally through written proposals to be considered at Admin Board meetings; seeks approval of College Graduate Studies Committee and College Associate Dean for Academic Affairs prior to submitting to Admin Board;
- Assists the Graduate School in conducting the annual and 8-year (or shorter as required by accrediting bodies) reviews of the graduate program, by initiating the self-study process upon notification by the Graduate School.

1.5 Graduate Services Coordinators

The Graduate Services Coordinators (https://grad.ncsu.edu/about/people/gsc/) serves as the principal administrative liaisons between the student, the Graduate Program Director, the graduate program, and the Graduate School. In this capacity, the Graduate Services Coordinator:

1. Processes admissions applications, collects all supplemental documents required by individual programs, and submits the materials and recommendations to the Graduate School;
2. Prompts students to meet critical Graduate School milestones to promote retention and timely completion, including preparing Plans of Work, appointing advisory committees, adding and dropping courses, maintaining continuous registration, monitoring graduation applications, and requesting the scheduling of oral exams;
3. Assists students and Director of Graduate Programs in preparing and submitting various forms and documents that require Graduate School approval. These include, but are not limited to, requests for leaves of absence, Graduate Plans of Work, committee appointments, requests for preliminary and final oral exams, grade changes, transfer requests, and reinstatements;
4. Develops proficiency in using the Student Information System (SIS), the Graduate School Information System databases, and other information systems to facilitate all graduate-student-related correspondence with the Graduate School.

1.6 Graduate School Representatives

The Graduate School Representative has a unique role on the doctoral examination committee. The Representative protects the interests of the student, the advisory committee, and the Graduate School. The Graduate School Representative is also an “unbiased person” to whom the Dean may turn for judgment and counsel. [Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 10/27/86.]

A. Appointment Process

If a doctoral graduate committee has no representation outside of the student’s graduate program, a Graduate School Representative is required. Co-chairs can never be considered unbiased, even if they are from outside the student’s graduate program, and would therefore never be able to substitute for the Graduate School Representative.

The Dean of the Graduate School chooses Representatives at random from the Graduate Faculty. Each member of the Graduate Faculty is expected to serve in this capacity. The Dean appoints the Graduate School Representative after the doctoral student’s Plan of Graduate Work is approved. An effort is also made to make no more than two such assignments to a faculty member at any one time. It is the responsibility of the student to schedule preliminary and final examinations that are satisfactory to the Graduate School Representative and to provide the Representative with a copy of the dissertation one week before the final oral.

B. Responsibilities

The primary responsibility of the Graduate School Representative is that of an observer. Consequently, the Representative should be invited to participate in both the preliminary and final oral examinations, but should never take a dominant role in the exams. The Representative is expected to contribute to the scholarly atmosphere of the examination. Moreover, the experiences of faculty members who serve as Graduate School Representatives should improve the overall quality of graduate education.

The Graduate School Representative also signs the official examination form and may include comments. The Representative expected to express concerns (if they exist) and encouraged to note any exceptional strengths of the examination. The Graduate School Representative should:

1. Sign the form without comment;
2. Sign the form and note any specific comments; or
3. Sign the form and note that a letter to the Graduate School Dean will follow (with copies to the committee).

The Representative may wish to comment on:

1. the appropriateness of the committee;
2. the adequacy of the Plan of Graduate Work;
3. the appropriateness of the examination questions and procedures;
4. the quality of the student’s performance; and/or
5. reservations about the dissertation.

A signature with no comments indicates that the Representative believes that the examination was properly conducted and does not take exception to the findings of the committee. The signature does not imply the Representative’s approval of the substance of the examination or dissertation. In the event the Graduate School Representative indicates any substantive reservation, the Dean of the Graduate School will investigate and decide the course of action.

Note: Serving as a Graduate School Representative is a requirement of Graduate Faculty status. Exceptions are made only on an individual basis and in cases of emergency.

1.7 Administrative Board of the Graduate School

A. Mission

The Administrative Board of the Graduate School advises the Dean of the Graduate School on all matters pertaining to graduate education at NC State.

B. Membership

Voting Members

The Administrative Board is comprised of 23 voting members. The voting members consist of elected as well as appointed members and represent all colleges, interdisciplinary graduate programs, the Faculty Senate and the Graduate Student Association (GSA). Each college is represented by two Graduate Faculty members. One representative is elected by the college’s Graduate Faculty as coordinated by the Associate Dean or college designee responsible for graduate education. The second representative is appointed by the College Dean. The interdisciplinary member is appointed by the Dean of the Graduate School. Board members representing the Faculty Senate and GSA are appointed annually by the Chair/President of those organizations.

Terms of elected members and interdisciplinary representative are three years starting on July 1, and these members may serve for two consecutive terms, although they may serve subsequent terms following a hiatus. The terms for each college’s representatives should be staggered so that both members do not exit the Board simultaneously. Although the expectation is that members will complete their entire term, if that is not possible, then a replacement may be identified by the respective college or unit to complete the remainder of the term. The Board’s Coordinator will notify university units in April of a Board member’s ending term. The unit should provide the name of the new Board member to the Administrative Board Coordinator no later than May 15.

Non-Voting Members

Non-voting members represent and provide insight from other important university offices including one representative from the Distance Education and Learning Technology Applications (DELTA), the Southeastern SACS Liaison, and Registration and Records. The Graduate School is also represented by non-voting members to provide insight about Graduate School administration and policies.

The current list of Board members and their contact information can be found at https://grad.ncsu.edu/about/people/admin-board (https://grad.ncsu.edu/about/people/admin-board/).

C. Meetings

The Administrative Board is chaired by the Dean of the Graduate School and meets biweekly during the academic year.

Agendas and minutes from previous meetings will be posted to the Graduate School website (https://grad.ncsu.edu/about/people/admin-board/minutes (https://grad.ncsu.edu/about/people/admin-board/minutes/)) at least one week prior to each meeting.

A quorum (12 voting members) must be present to hold a meeting of the Administrative Board. If a quorum is not met, the meeting and all agenda items will be postponed until the next scheduled meeting.

Given the nine-month appointments of many faculty members, board members are expected to be available from August 1 through May 15 to review action items for the academic year, but are generally not expected to review items over the summer.

1.8 Common Administrative Board Actions

A. Course Actions

The Board reviews and recommends for approval course actions for the creation, deactivation, and revision of all graduate and professional (#500-level) courses. These course proposals may be submitted at any time. However, if the desired effective term for a new course is the immediately following semester, the Administrative Board Coordinator must receive proposals by the following deadlines:

Date Due to Administrative Board Coordinator	Desired Effective Term
February 1	Summer
March 15	Fall
September 15	Spring

B. Program Actions

The Board reviews and recommends the following program actions:

- new graduate degree programs, concentrations, and certificates
- discontinuation of degree programs, concentrations, or certificates
- revision of degree program curriculum requirements
- changes to the title or in the CIP code of an existing degree program or concentration

C. Workflow

All items reviewed by the Administrative Board follow the following steps (for a more comprehensive listing of the steps see https://grad.ncsu.edu/faculty-and-staff/program-development (https://grad.ncsu.edu/faculty-and-staff/program-development/)):

1. Proposals are initiated in the program/department;
2. Upon program/department approval, the proposals are routed through the college for review by the respective Graduate Studies Committee and the college dean; interdisciplinary programs may require the approval of multiple colleges;
3. Upon college dean approval, the proposals are sent to the Administrative Board Coordinator in the Graduate School;
4. Proposals are reviewed by the Assistant Dean for Program Development;
5. Proposals are reviewed by three Administrative Board voting members;
6. Proposals are placed on the meeting agenda for review and vote by the full Board;
7. After Board recommendation and Graduate Dean approval, no additional approvals are required for curriculum revisions and concentrations. Course actions are sent to Registration & Records for implementation and program actions are sent to the Provost's office to continue through the university and, where applicable, UNC system routing processes.

Note: at any point in this process, the proposal may be sent back to the instructor, program, or department for revision.

D. Graduate Policies

Reviews, revises, and recommends for approval revisions to graduate policies contained within the Graduate Handbook.

E. Memoranda of Agreement/ Understanding

Reviews and recommends degree-related agreements, including both domestic and foreign, that pertain to the graduate academics. The routing for these memoranda is identical to that for new programs (see above).

F. Extensions to Time Limits beyond Two Years

Although the Graduate School recommends extensions to the time limits of up to two years, for extensions exceeding these limits, students accompanied by their major professor and DGP must present the rationale for a continued extension to the Administrative Board. The Board will determine whether or not a further extension should be granted.

G. Degree Conferral

Each semester recommends the conferral of graduate degrees for both master's and doctoral degrees, with the exception of the Doctor of Veterinary Medicine.

H. Posthumous Degrees

Posthumous degrees may be requested for graduate students who are close to completing their degree requirements (see 3.20 – Graduation for additional details (p. 955)).

2.1 Applications

A. Receiving the Application

All applicants to graduate programs and/or certificates must submit the online NC State University Graduate School Application Form (https://grad.ncsu.edu/apply/), including a statement of purpose and the North Carolina Residency Form (if necessary for tuition purposes). Recommenders identified by the applicant during the online application process also submit references online. An unofficial transcript from each college or university previously attended should be uploaded. The

Graduate School encourages applicants to pay all application fees by credit card.

Required Documents

Applications for degree-seeking graduate students are not complete until the Graduate School receives a non-refundable application fee and the following documents (for Certificate applications see Section x.x).

- An unofficial transcript from all colleges and universities where they have or will obtain a degree; (Note: Applicants currently attending or who have previously attended NC State are not required to provide an NC State transcript.)
- Three recommendations from people who know the prospective student's academic record and potential for graduate study;
- Online North Carolina Residency Form if claiming NC residence for tuition purposes submitted within one (1) week of application submission;
- Additional program requirements, such as official GRE or other standardized test scores, statements of purpose, portfolios or other work samples (documentation of these additional programmatic requirements can be linked to through the Fields of Graduate Instruction website); and
- Where applicable, official TOEFL or IELTS scores.All supporting documents should be uploaded to the application prior to submission, and cannot be updated after submission. Other than official transcripts, paper documents should not be mailed to the Graduate School.

Transcript Requirements

Legible, unofficial copies of transcripts should be uploaded to the application for review purposes. Upon recommendation of admission, the University requires that official transcripts that document all prior conferred/awarded degrees be on file in the student's permanent record at NC State. The transcript(s) must include a statement of any degree(s) awarded. At the time of application, some students are enrolled in a degree program and can only provide an incomplete official transcript at the time an admission decision is reached. The official, complete transcript(s), including statements of all degrees awarded, must be submitted to the Graduate School no later than the last day of classes of the first semester they are enrolled. An initial hold will be placed on a student's registration if they fail to supply the transcripts with possible termination should they not be provided.

Deadlines for Applications

The Graduate School must receive the application and all supporting documents no later than the deadlines specified by the Graduate School and/or the program; numerous programs have earlier deadlines than those established by the Graduate School. Applicants are responsible for meeting any earlier deadline established by a graduate program to which the prospective student is applying (see the Fields of Graduate Instruction website for links to program deadlines).

Conditions of Admission

Final acceptance at NC State is contingent upon completion and official documentation of any degree (bachelor's or master's) listed in an applicant's application. It is the applicant's responsibility to maintain a level of academic performance that meets university and program admission standards. Poor performance during the last semester(s) could jeopardize an applicant's admission. Likewise, students currently enrolled in Post Baccalaureate Studies (PBS) or who request an admissions deferral and take PBS coursework must also maintain a level of academic performance that meets the university's and program's admission standards. Failure to comply with these conditions could, at the discretion of the program and/or Graduate School, be grounds for changing the admission status.

Length of Application Validity

An application is valid for 12 months from the date it was submitted by the applicant.

Number of Programs for Which Applicant Can Be Considered

An application is only valid for admission consideration by one graduate program. If an applicant wants to be considered for admission to additional programs, they must re-apply and pay an additional application fee for each program they apply to.

B. Waiving the Application Fee

Under exceptional circumstances, the Graduate School may waive the application fee. (https://ncsu.service-now.com/gradschool/?id=kb_article&sys_id=5eab88dbdbce4f40de08f1a51d9619cf)

C. Processing Applications

All Applications

Applicants must ensure that all of the required materials are submitted. When the Graduate School receives a completed application and the application fee, an admission record is created for the applicant and their application is made available to the program of interest.The DGP and the graduate program review the completed files of all applicants in accordance with the Graduate School's guidelines for final admission or denial decisions. The DGPs then submit their recommendations to the Graduate School.

The Graduate School reviews the departmental recommendations and, in cases where the Graduate School concurs with an admission decision, requests official transcripts. Once the official transcripts are received and verified, the Graduate School posts the final admission decision. When the Graduate School denies a program's recommendation for admission, the program has the option of supplying further justification to the Graduate School. However, the Graduate School has the final decision.

International Applications

Before international applicants' admission status can be finalized, they will need to submit a completed Certificate of Financial Responsibility (CFR) and/or a Visa Clearance Form (VCF), depending upon their visa status, directly to the Graduate School. Once the CFR and/or VCF are approved, applicants must accept the offer of admission before a Certificate of Eligibility (Form I-20 or DS-2019) will be created (see Section x.x for detailed information on International Applications).

D. Reapplication

Students denied admission into a graduate program may be reconsidered for admission at a later time upon submission of a new application and supporting materials.

2.2 Application Deadlines

A. U.S. Applicants and Permanent Residents

The following dates are Graduate School application deadlines. Many programs have earlier deadlines (see URL). Applicants should submit applications and all supporting documents on or before the Graduate School or program deadline, whichever is earlier.

Application and Fee Due in Graduate Admissions Office

Semester	Deadline
Fall	June 25
Spring	November 25
Summer I	March 25
Summer II	May 10

B. International Applicants

The following dates are Graduate School application deadlines for international applicants. . Many programs have earlier deadlines (see URL). International applicants should submit applications and all supporting documents on or before the Graduate School or program deadline, whichever is earlier.

Application and Fee Due in Graduate Admissions Office

Semester	Deadline
Fall	March 1
Spring	July 15
Summer I	December 15
Summer II	December 15

C. Late Applications

1. Departments are under no obligation to review or consider any applications received past their program deadlines.
2. Should departments wish to consider late applications, they may do so without requesting special waivers from the Graduate School.

2.3 Graduate School Admissions

A. Types of Admission

The criteria used for admissions decisions vary by program, reflect an evaluation of the applicant's potential for graduate work, and consider the ability of a program to accommodate additional students. Departmental admissions committees consider requests for admission and forward their recommendations to the Graduate School. However, Graduate School regulations govern the criteria for the classification of graduate student status. Programs should first determine the appropriate status of the student before forwarding their admission recommendations to the Dean of the Graduate School.

There are three types of admission to graduate study at NC State:

- Full-graduate standing
- Provisional
- Graduate-unclassified

B. Full Graduate Standing

To be considered for admission in full graduate standing, applicants must have:

- (a) a four-year bachelor's degree (or equivalent) from a regionally accredited college or university. Exceptions to standard accreditation may be granted for applicants with international degrees, including applicants with three-year degrees from institutions in Europe participating in the Bologna Process.
- (b) a GPA of at least 3.00 (on a 4.00 scale) in their undergraduate degrees.

C. Provisional Admission

Students may be granted provisional status when they do not fully meet all the necessary requirements for admission to the Graduate School, but their circumstances warrant provisional admission.

1. Students with related bachelor's degree and overall bachelor's GPAs that fall below 3.000 on a four (4)-point scale)Provisional admission may be granted to students with related bachelor's degrees from regionally accredited institutions whose GPAs fall below 3.00 standards for admission to full graduate standing when:
   a. unavoidable, extenuating circumstances affected their undergraduate averages, or
   b. progressive improvement in their undergraduate work warrants provisional admission.Students can attain full-graduate standing after completing nine or more graduate credit hours with a minimum 3.000 GPA. Courses taken for S/U grade cannot be used as part of the minimum.A graduate student is not eligible for appointment to an assistantship or fellowship while on provisional status.
2. Students with non-related bachelor's degrees (from accredited institutions)The Graduate School may grant provisional admission to applicants with bachelor's degrees from accredited institutions who lack undergraduate work considered essential for graduate study in a major field.The Graduate School grants full-graduate standing when the deficiencies responsible for the provisional status are corrected through additional coursework. The student must also maintain a satisfactory academic record (3.000 GPA) on all coursework taken in a graduate classification. The graduate program must also recommend that full graduate standing be granted to the student seeking admission.

D. Graduate-Unclassified Status

The Graduate-Unclassified status is a temporary classification for students, such as foreign visitors (see Section 2.4), who are not candidates for degrees. Students may take courses for graduate credit but may not apply more than 12 credits to any program leading to an advanced degree at NC State.

Unclassified graduate students must meet the same admissions requirements that apply to graduate students in full standing. Individuals interested in applying for admission as Graduate-Unclassified Students should contact the graduate program of interest.

E. Eligibility for Student Status in a Graduate Program

Students who graduate from a degree program can no longer register as students in that program unless they are formally admitted to a new graduate classification (e.g., from a master's to a doctoral degree). Students with specific educational goals not encompassed by traditional degree programs may request admission in the "Graduate-Unclassified Status" or register in the "Post-Baccalaureate Studies" program through Registration and Records (https://registrar.ncsu.edu/).

F. Process of Admission or Denial

Using the online DGP Decision Recommendation form, the Director of Graduate Programs (DGP) indicates via a checkbox on the form that all information is accurate (including GPA information) and that the decision recommendation is ready for communication to the applicant.

After reviewing the applicant's file and, if necessary, consulting with the appropriate DGP, the Graduate School notifies the applicant of acceptance or denial of admission. The DGP and the applicant will have access to this letter via the online system. DGPs should only notify an applicant regarding admission after the official notification of admission is posted online by the Graduate School. A template departmental admission letter is available for that use.

G. Advanced Enrollment Deposits

1. Some graduate programs require a deposit for newly admitted masters and doctoral students to enroll. Admitted students must confirm their intent to enroll via the link in their online decision letter by filling out the enrollment form and paying their enrollment deposit. The non-refundable deposit will be credited toward tuition for the student's admit term; there is also a processing charge. The deadline to submit the enrollment deposit will be June 15 for Fall and Summer terms/sessions, and November 15 for Spring, or within two weeks of an admission decision rendered after these deadlines.
2. Advanced enrollment deposits are term specific. Should a student receive approval for deferment of their admission to a future term after having paid the advanced enrollment deposit, they must request a deferral of their enrollment deposit by notifying the Graduate School by September 1 of the year in which they were originally admitted. Failure to request a deposit deferral by the due date will result in forfeiture and a new deposit will be required for the future term. Exceptions cannot be granted to this policy.
3. Sponsored students (research assistants, teaching assistants and fellows) are required to pay the enrollment deposit. When tuition awards are posted to these students' financial accounts, the amount of the advanced enrollment deposit will go toward student fees. If student fees are covered under the sponsorship, then the deposit amount will be refunded by the University Cashier's office.

H. Exceptions to Standard Admission

1. Doctoral applicants with previous doctoral degrees. An individual who has a doctoral degree will be denied admission to a doctoral program at NC State. The Dean of the Graduate School may make exceptions based upon departmental recommendations.
2. Applicants to graduate programs without bachelor's degrees but with professional degrees. The Graduate School may consider an applicant who does not possess a bachelor's degree, but who has earned a D.D.S., D.V.M., J.D., PharmD, or M.D. degree from a regionally accredited institution for admission to a graduate program.
3. Applicants who have a previous Master's degree in the program to which they are seeking admission. The Graduate School will not admit or transfer a student to a Master's program if the student already holds a Master's degree in the same discipline. Exceptions may be considered if a statement of justification is provided by the DGP and is then approved by the Dean of the Graduate School.

I. Date of Admission

1. Deferral of Admission. Registration is automatically canceled when students do not enroll for the semester or summer session for which they received admission. Any applicant wishing to defer the admission date must submit a written request to the graduate program. Both the graduate program and the Graduate School must approve the request. The maximum time that a student may be granted a deferral is one year.
2. Ineligibility for leave of absence prior to enrollment. Leaves of absence are available only to currently enrolled students or students already on an approved leave of absence. Students who are admitted for an upcoming semester, but are unable to register, must request a deferment in writing to their graduate program and Director of Graduate Programs.

J. Readmission

Students must reapply if they are terminated at NC State because of non-compliance with the continuous registration policy and wish to resume study in their original graduate program. The student must submit a new application and pay the application fee, submitting all materials as if applying for the first time. However, letters of recommendation and GRE scores less than five years old that are on file in the Graduate School or department may be transferred to the second application, upon request.

If the program approves the student's request for readmission, the Director of Graduate Programs must submit both a letter of justification and an online DGP Decision Recommendation form to the Graduate School on the student's behalf. The Graduate School makes the final decision on the student's readmission.

K. Contractual Readmission for Master's Students

In rare circumstances, a program may request that the Graduate School contractually readmit a student. Contractual readmission permits students, who had **previously enrolled in a master's program** at NC State and obtained GPAs below a 3.00, to pursue a **master's degree in another field** and have their GPAs reset. The program requesting this readmission must be different from the one in which the student was originally enrolled. Students must complete the Graduate Contractual Readmission form and this must be approved by the new program's DGP and the Graduate School. This process will not remove the previous coursework from their NC State transcript, but it will allow the calculation of the graduate GPA to commence when they enroll in the new program. Furthermore, this process requires a break in enrollment; the coursework for the prior program must have been completed **at least two years** prior to the term in which the student will re-enroll.

L. International Admission Pending Receipt of Certain Documents

International students cannot be admitted until the Graduate School receives additional documentation required by both the US Citizenship and Immigration Services (https://www.uscis.gov/) (USCIS) and the Graduate School (see Section 2.4 (p. 933)).

M. NC State Faculty Enrollment in Degree Programs

Any NC State faculty member, regular or special, may enroll in an NC State program to pursue an advanced degree, provided they have the prior approval of their Department Head and Dean. Annual renewal or rescinding of approval must occur by letter in the faculty member's personnel file. The Department Head and Dean are responsible for ensuring that no conflict of commitment, conflict of interest, unethical or improper actions, or privileges are incurred in this process.

N. Post-Baccalaureate Studies (PBS) Classification

Those who wish to undertake academic work beyond the bachelor's degree, but are not currently admitted to a graduate degree program, may enroll under the Post-Baccalaureate Studies (PBS) classification. This classification is open only to US citizens, permanent residents, and international students who are sponsored by an agency of the US government or are married to an NC State student. Registration is through Registration and Records.

Rules for Participation in PBS

The following are university minimum requirements, although home departments may have more restrictive requirements.

1. All applicants must have a bachelor's degree from a regionally accredited institution of higher education.
2. All classes taken for credit by PBS students will be graded in the usual manner that applies for the particular course (A+ through F or S/U). All courses taken at NC State will appear on the student's transcript.
3. Registration is limited to a maximum of two courses per semester. Individuals who are employed full-time should limit their PBS registrations to one course per semester.
4. The GPA of a graduate student who has credits in the PBS category will be based on all courses taken at the 400-800 level. If PBS courses are included in a student's degree program, his/her degree clock for time-to-completion starts with the first course approved for inclusion in the Plan of Work.
5. If a student's graduate degree program is terminated, he/she cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.
6. The student's advisory committee must approve all coursework accepted for degree credit. Requests for degree credit for courses completed in the PBS classification are considered after admission to a graduate degree program when the student's Plan of Graduate Work is filed with the Graduate School.
7. The PBS classification carries with it no implication that the student will be admitted to the Graduate School in any degree classification or that courses taken will be accepted for degree credit.
8. PBS students are required to familiarize themselves with Graduate School and departmental policies and to seek further advice or clarification as needed.

O. Teaching Certificate Renewal

Public-school personnel who are primarily interested in "certification credit" may enroll in the PBS program without forwarding transcripts of previous work to the Graduate School. However, these students must be admitted in the Graduate-Unclassified status before completing their certification. The College of Education determines the applicant's qualifications for enrollment.

P. English Proficiency Requirements for International Applicants

To be eligible for admission to graduate study at NCSU, all non-US citizen applicants (i.e., non-resident aliens and permanent residents) must demonstrate proficiency in English at a level necessary to be successful in a graduate program at NC State. This requirement can be met for most applicants in one of the following ways; however, some programs may require additional evidence of English proficiency:

1. Provide Test of English as a Foreign Language (https://www.ets.org/toefl/) (TOEFL) with a total score of at least 80 on the Internet-based Test (iBT), and with minimum test scores for each section of:
   - Listening 18 points
   - Reading 18 points
   - Writing 18 points
   - Speaking 18 points – for admission, 23 points – for TA appointment where TA has direct verbal interactions with students, 26 points – for TA appointment where TA presents lectures in the class or laboratory NOTE: The current computer- and paper-based versions of the TOEFL test will be given until the iBT version is implemented in a particular location. Computer-based TOEFL scores must be 213 or higher (with at least 17 on three sections and no section score below 13). The paper-based test requires a score of 550 or higher (with scores of 50 on at least two of the three sections and no section score below 45).
2. Provide International English Language Testing System (https://www.ielts.org/) (IELTS) scores with an overall band score of at least 6.5. Minimum test scores for each section are listed below:
   - Listening 6.5
   - Reading 6.5
   - Writing 6.5
   - Speaking 6.5 – for admission, 7.0 – for TA appointment
3. Provide Duolingo (https://englishtest.duolingo.com/) with a total score of 110 or better.
4. be a citizen of a country where English is the official language (https://grad.ncsu.edu/students/rules-and-regulations/handbook/english-as-official-language/) and the language of instruction in higher education;
5. have successfully completed at least one year of full-time study in a degree program at a regionally accredited four-year US College or university.

TOEFL or IELTS test scores must be no older than two years (24 months) prior to the beginning of the requested entry term.

2.4 Admission of Non-U.S. Citizens

International (non-U.S. citizen) applicants and U.S. Lawful Permanent Residents may be recommended for admission by the academic department, but cannot be granted official admission by the Graduate School until certain critical documents are received and approved by the International Admissions Specialist. The requirements in this section are only for admission purposes and do not reflect or affect an admitted student's tuition or tax residency determination.

Applicants who are foreign nationals abroad, U.S. Lawful Permanent Residents, DACA recipients or non-U.S. citizens already residing in the U.S. must complete additional paperwork, known as the Visa Clearance Form and/or Certificate of Financial Responsibility, as part of their application, which will be reviewed by the International Admissions Specialist in the Graduate School. Eligible international applicants who are abroad will be issued a visa document by the Graduate School to apply for the student visa required to study in the United States. Current NC State students will have their new visa document issued by the Office of International Services (OIS) (https://internationalservices.ncsu.edu/). OIS staff members also provide immigration and cross-cultural assistance to students on F or J nonimmigrant visas throughout their program at NC State.

A. Visa Types and Eligibility

Under immigration law, international students are divided according to their immigration classification. Each visa type has its own eligibility requirements and restrictions.

1. F-1 Student – a resident of a foreign country who is coming to the U.S. temporarily and solely for the purpose of attending a full-time degree program. An F-1 student is required to demonstrate full financial support to obtain the F-1 visa and I-20 visa eligibility document and be admitted to the U.S. There are numerous requirements and restrictions regarding enrollment, employment, travel, etc., and detailed information is available from OIS. Graduate certificate programs, online/distance programs, and part-time programs are not eligible for the F-1 visa status.
2. J-1 Exchange Visitor – a classification that serves a variety of educational purposes. Under this status, students, scholars, professors, and researchers may come to the U.S. temporarily for the purpose of educational exchanges under the sponsorship of an approved organization or institution. Students often enter the U.S. in J-1 Exchange Visitor status when they are participants in sponsored activities such as the Fulbright program.
3. Other Visa Types – in addition to F-1 and J-1, there are other visa types represented among the international student population at NC State, such as H-1B, TN, O, E visas, and DACA recipients. Applicants already in the U.S. in these non-student visa types must submit proof of their legal status and may apply for any type of program if they will maintain this visa type for the duration of their program.
4. Lawful Permanent Residents of the U.S. (“Green Card holders”) – may apply for any type of program, but will need to submit their Permanent Residence Card (“Green Card”) during the admission process. Permanent Residents may pay the domestic student application fee price.

B. English Proficiency Requirements

In order to be eligible for admission to the Graduate School, all non-U.S. citizen applicants (including U.S. Permanent Residents) must demonstrate proficiency in the English language at a level necessary to be successful in a graduate program at NC State (see English Proficiency Requirements (p. 930)).

C. Visa Clearance Form

Applicants who are U.S. Lawful Permanent Residents or non-citizens already residing in the U.S. must complete the Visa Clearance Form (VCF) as part of their application. International applicants already in the U.S. in a status that allows study must indicate on the Visa Clearance Form whether they wish to remain in their current nonimmigrant status or change their status to the F-1 student visa status. Because processing times at U.S. Citizenship and Immigration Services are sometimes long and there are many factors that must be taken into consideration when deciding to change one’s status, applicants considering changing status should contact the International Admissions Specialist early in the admission process. A link to the online Visa Clearance Form is available in the applicant’s portal when the Graduate School sends the academic acceptance letter; applicants cannot access it or complete it until this point in time. The applicant should complete this form as soon as possible once it becomes available to enable the Graduate School to grant official admission.

D. Certificate of Financial Responsibility

The Certificate of Financial Responsibility (CFR) is only required for those applicants who will be applying for or are already in the student visa status (F-1 or J-1). The CFR requires the candidate to provide evidence of the financial resources necessary to cover all expenses, including those of any accompanying dependents, for each year of study. Once approved, the Graduate School (or OIS if a current NC State student) will then issue the Certificate of Eligibility Form I-20 for an F-1 visa or Form DS-2019 for a J-1 visa, depending on which status the applicant qualifies for. International applicants can check on the status of their application/admission, including when the Certificate of Eligibility was issued, by going to: http://www.ncsu.edu/applygrad (http://www.ncsu.edu/applygrad/). A Lawful Permanent Resident of the U.S. (“Green Card holder”) or any other non-citizen not requiring a student visa is not required to demonstrate financial ability on the CFR and needs only to complete and submit the Visa Clearance Form.

E. Health Insurance Requirement

Hospitalization costs in the U.S. are high and having appropriate health insurance is a requirement for all international students at NC State in F-1 or J-1 status. All international students in F-1 or J-1 status must purchase the University student health and accident insurance plan (or opt out through the universities hard-waiver program if other acceptable health insurance has already been purchased) throughout their program of study at NC State. Those who do not maintain this required insurance will have a hold placed on their ability to register.

F. Letters of Assurance for Research Participation

The Board has determined that no international students are required to sign Letters of Assurance, such as those occasioned by the Export Control Act, as a condition of participating in research activities.

G. Full-time Status Requirement

International students in F-1 or J-1 status must carry a full course load in each regular semester to comply with the US Citizenship and Immigration Services (https://www.uscis.gov/) (USCIS) regulations. Please refer to Section 3.15 for information on determining full- and part-time status.

H. Assistantship and Employment Limitations

International students in F-1 or J-1 status may not hold graduate assistantships or a combination of assistantships/positions that exceed 20 hours of service work per week during Fall and Spring semesters since this jeopardizes their student status with USCIS. However, these students can have appointments up to 1.0 FTE during the Summer sessions if the summer is considered a vacation term for the student and they will be returning the following fall. For those employed in other capacities on-campus, please visit the OIS on-campus employment webpage (https://internationalservices.ncsu.edu/student-employment/on-campus-employment/) for policies and restrictions. International students should consult with OIS before accepting any type of employment. Employment regulations vary by visa type.

I. Three-Year Bachelors Degrees

Admissions rules require that an applicant have a bachelor's degree from an accredited college or university as determined by a regional or general accrediting agency. These accrediting agencies define bachelor's degrees, in the U.S. custom, as requiring four years to complete. In reality, it may take longer or shorter to complete the degree, but the amount of work involved is typically the same. Confusion may arise as to the equivalence of three year bachelor's degrees offered in some countries. Some are treated as equivalent to the U.S. bachelor's (see below) whereas others may require outside evaluation.

1. The Graduate School only accepts three-year bachelors degrees from member institutions (http://www.ehea.info/pid34250/members.html) within the Bologna Process (http://www.ehea.info/). If the institution is not part of this organization, the applicant will be asked to provide an evaluation of their higher education background by an international credential evaluation company. If the evaluation determines that the background is not equivalent to a U.S. bachelor's degree, admission will be denied. If the academic background includes a master's degree, that should be evaluated along with the three-year degree to see if the combination is equivalent to a four-year U.S. bachelor's degree. If any part of the master's degree is needed for equivalency, the student will not be entitled to the 18 hour allowance toward a Ph.D. program granted to holders of a previous master's degree. On the other hand, they will be afforded the extra two semesters under the Graduate Student Support Plan for students without a previous master's.
2. We accept international credential evaluations from members of NACES (http://www.naces.org/members.htm) (National Association of Credential Evaluation Services) or AICE (http://www.aice-eval.org/) (Association of International Credential Evaluators). Others may be acceptable as well, but please check with the Graduate School if a question arises as to the appropriateness of the evaluation.
3. The University of Wisconsin hosts a directory of foreign institutions (http://www.grad.wisc.edu/admin/gradcoordinators/iadmiss/) describing their institutional academic environment and the expectations UW has for applicants from these institutions. This should only be used as a guide.

2.5 Medical History and Immunizations Requirements

All graduate students admitted to a degree program are required by State law to submit a report of medical history and immunization documentation prior to initial registration. Both forms are available online through the HealthyPackPortal (https://healthypack.dasa.ncsu.edu/healthweb/). This report must document immunization against tetanus/diphtheria, measles, German measles, polio, and for international students from a high risk country, show results of a tuberculin skin test (must be completed at U.S facility) or TB blood test. Graduate students who have recently completed their undergraduate work at NC State must update their medical history. Student Health Services (https://healthypack.dasa.ncsu.edu/) must receive the required reports at least 30 days before registration. If the student does not meet this requirement, dismissal from school is mandatory under the law.

3.1 Graduate School Minimum Requirements

A. Master of Arts and Master of Science

All Master of Science and Master of Arts degree programs are planned with the objective of making possible a reasonable, comprehensive mastery of the subject matter in a chosen field. In most cases, the Master of Science and Master of Arts programs provide training and experience in research in order to familiarize the student with the methods, ideals and goals of independent investigation. In these cases, representative of most Master of Science and Master of Arts degree programs, a thesis is required. A small number of Master of Science and Master of Arts programs do not require a thesis.

Students in the Master of Arts or Master of Science programs follow the individual program and the Graduate School requirements that were in effect when they entered the program.

The following are minimum requirements for a degree in Master of Science or Master of Arts degree programs:

1. A minimum of 30 semester hours of graduate work in the degree program, unless the specific program requires more hours.
2. A reading knowledge of a foreign language (in a few programs; see Section 3.5 (p. 939))
3. A comprehensive written examination (in some programs)
4. A thesis (in most programs)
5. A comprehensive oral examination (except Option B programs)

Note: Requirements for ALL master's degrees must be completed within six (6) calendar years. For further information about the time limited for degrees, see Section 3.4 (p. 939).

B. Master's Degree in a Designated Field

A number of departments and programs offer master's degrees in designated fields. These are professional degrees and do not require a thesis. Master's Thesis Research (XXX 695) may not be included as part of the Plan of Work.

Requirements include the following:

1. A minimum of 30 semester hours of graduate work in the degree program (unless the specific program requires more hours).
2. A comprehensive written examination (in some programs)
3. A comprehensive oral examination (except Option B programs)

C. Option B Master's Degree

The Option B Master's degree requires that students adhere to the general guidelines for a Master of Arts or Master of Science degree with the following exceptions:

1. A comprehensive oral exam is not required
2. A thesis is not required
3. Master's Thesis Research (XXX 695) may not be included as part of the Plan of Work
4. Individual departments define other requirements for their Option B program, such as additional course work or final projects
5. Option B Master's degree programs cannot carry an officially designated minor
6. Students have a single assigned advisor rather than an advisory committee.

Changing Master's Programs to "Option B"

Master's degree programs that require final oral examinations may petition the Graduate School for permission to operate the program with a single advisor and to eliminate the final oral examination (Option B). Option B Master's degree programs may not carry an officially designated minor.

Petitions need the approval of school/college-level Graduate Studies Committees and must be made for an entire degree program, rather than for individual students. The Administrative Board of the Graduate School will review each petition and make appropriate recommendations to the Dean of the Graduate School. The petition form is entitled Proposal for Changing Non-Thesis Graduate Degree Program Requirements to Option B.

D. Credit Hour Requirements for Master's Degrees

[Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 6/17/2009]

A minimum of 30 semester credit hours is required for all master's degrees. Students may take more than the minimum hours required by their programs. The Graduate School does not give credit for non-credit course work (i.e. non-departmental seminars, workshops, short courses, conferences, and any "life experience" offerings). Furthermore, the Graduate School does not allow credit by examination.

The following are specific credit-hour limitations:

1. At least 18 credit hours must be graduate credits earned while the student is enrolled in the graduate program.
2. The remaining 12 credit hours or more, depending on the requirements of the specific program, may be transferred from any of the sources or any combination thereof set forth below as transfer credit.
3. At least 18 credit hours of letter-graded courses ("A," "B," "C", etc.) must be included in the program. These must be NC State or inter-institutional courses.
4. No more than six credit hours of 400-level (undergraduate) courses may be counted toward the degree, and they may not come from the major field.
5. Credit hours for the following courses may NOT be used to satisfy the 30-credit hour requirement: Non-Thesis Master's Examination (XXX 690), Summer Thesis Research (XXX 696), Non-Thesis Master's Continuous Registration (XXX 688 and XXX 689).
6. No more than 12 credit hours may be used to satisfy degree requirements for another master's degree program at NC State, unless the student did not complete the other program. (See Section 3.11.A Multiple Master's Degrees).
7. Courses at the 900 level may not be counted toward a master's degree.

Transfer of Credits

1. Transfer of graduate credits earned at other universities. A course that was completed at another college or university may be considered for transfer to a master's program provided that:
   a. The course is classified as a graduate course.
   b. It was completed while the student was in a graduate or post-baccalaureate classification.
   c. It was not taken as a part of a previous master's degree program at another institution.
   d. The grade in the course is B or better. Courses with grades of B- or lower will not be allowed to transfer.
   e. The college or university is accredited by one of the following six U.S. regional accrediting agencies: the Southern Association of Colleges and Schools, the Middle States Association of Colleges and Schools, the New England Association of Colleges and Schools, the North Central Association of Colleges and Schools, the Northwest Association of Colleges and Schools, or the Western Association of Colleges and Schools.

   Exceptions are allowed for transfer from international institutions if the department or program provides the Graduate School with adequate documentation that the course is relevant to the graduate degree and comparable to an equivalent course at NC State, and that the course was taught by faculty who are qualified to teach at the level of a master's degree. Where the grading system and grading culture in such institutions differ from that at NC State, students may (with the help of the Study Abroad Office) provide a letter to the Graduate School establishing the minimum average grade required for a graduate degree from that institution. That grade will be taken as the minimum grade for transfer in lieu of the "B" noted in 1(d) above.
2. Transfer of graduate credits earned while enrolled in an undergraduate program at NC State University. A course that was completed while the student was enrolled as an undergraduate at NC State University may be considered for transfer to a master's program or graduate certificate provided that it is at the 400-level (subject to the restrictions state in subsection D.4 above) or higher, that the earned grade is B or better, that it was not counted toward fulfillment of undergraduate requirements, and that it is verified by the undergraduate coordinator and recommended by the DGP. No credit will be allowed for a course completed in an undergraduate classification at another institution. Courses with grades of B- or

lower will not be allowed to transfer. (NOTE: Students admitted into a Accelerated Bachelor's/Master's (ABM) program may use up to 12 hours of graduate credit [500 or 700 level] to satisfy requirements for both the bachelor's and the master's degrees.)

3. Transfer of graduate credits earned while enrolled in a previous graduate degree program at NC State University. A graduate course that was completed while the student was enrolled in a previous graduate program at NC State University may be considered for transfer to a master's program, provided that: (a) The course was a letter-graded ("A," "B," "C," etc.) 500- or 700-level course and that the grade is B or better. Courses with grades of B- or lower will not be allowed to transfer; and (b) it was not taken as a part of a completed master's degree at another institution. Courses from other institutions cannot be transferred into a graduate certificate.
4. Transfer of Post-Baccalaureate Studies (PBS) graduate credits earned at NC State University. A graduate course that was completed while the student was enrolled in PBS status at NC State University may be considered for transfer to a master's or certificate program provided that it is at the 500 level or higher and that the grade is B or better. Courses with grades of B- or lower will not be allowed to transfer. All PBS credits that are used to satisfy requirements of a specific master's degree or graduate certificate must be earned before the student is admitted to that degree program. A maximum of 12 credit hours taken while in PBS status may be transferred into a master's degree program; a maximum of 6 credits taken in PBS status may be transferred into a graduate certificate. See Section 2.3 (p. 930) for information on admission to PBS classification. If a student's graduate degree program or certficate is terminated, s/he cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.

Submitting Transfer Credit for Graduate School Approval

When the graduate program submits the online Plan of Graduate Work through MyPack Portal, the DGP submits a letter requesting that any transfer credit be accepted as part of the student's master's program. An official transcript indicating the work to be transferred must accompany the letter.

E. Doctor of Philosophy and Doctor of Education

Doctoral students must demonstrate their ability to undertake scholarly research by writing a dissertation reporting the results of an original investigation, by passing a series of written and oral preliminary examinations in the field of specialization and related areas of knowledge, and by successfully defending the dissertation.

The following are requirements for the Doctor of Philosophy and Doctor of Education degree programs:

1. At least two (2) residence credit points secured in continuous semesters' residence as a graduate student at the University.
2. Doctoral degrees at North Carolina State University require a minimum of 72 graduate credit hours beyond the bachelor's degree.
3. Students cannot take 400-level courses or lower as part of the credit-hour requirement.
4. Students cannot use 900-level courses to satisfy the credit-hour requirement.
5. For a student who has a master's degree from a university other than NC State, a maximum of 18 hours of relevant graduate credit from the master's degree may be applied toward this minimum, upon the recommendation of the student's Graduate Advisory Committee. Therefore, the minimum credit-hour requirement in this case is 54 credit hours. Students whose previous master's was combined with a three-year bachelor's degree from a non-Bologna institution to meet the minimum requirements for admission will not be entitled to this 18 credit allowance and will not be considered to have a previous master's.
6. If a student completes a master's degree at NC State and continues for a doctoral degree without a break in time, up to 36 relevant credit hours taken while in master's status may be used to meet minimum requirements for the doctoral degree. If there is a break in time between completing the master's (at NC State) and beginning the doctorate (at NC State), the allowance is limited to 18 hours. Either allowance may include those 400-level courses taken as an approved part of the master's degree.
7. A graduate course that was completed while the student was enrolled in PBS status at NC State University may be considered for transfer to a doctoral program provided that it is a 500- or 700-level course and that the grade is B or better (see Section 2.3 (p. 930) for information on admission to PBS classification). Courses with grades of B- or lower will not be allowed to transfer. All PBS credits that are used to satisfy requirements of a specific doctoral degree must be earned before the student is admitted to that degree program. These courses must be evaluated and recommended by the student's advisory committee on the basis of appropriateness and currency of the course material. In such cases, the student's degree clock starts with the first of these courses approved for inclusion in a plan of work (POW). Final approval is given by the DGP upon submission of the POW to the Graduate School. A maximum of 12 credit hours taken while in PBS status may be transferred into a doctoral degree program.
8. Students who hold a Ph.D. are generally not admissible for a second Ph.D. unless a "special exception" is requested and granted (see Section 2.3 (p. 930) and REG 2.15.01).
9. A successful preliminary comprehensive examination (written and oral components)
10. A dissertation.
11. A successful final comprehensive oral examination (dissertation defense).

Note: Doctoral students must attain candidacy for the degree within six (6) calendar years. The time limit for completing all requirements for the Doctor of Philosophy and Doctor of Education degrees is noted in Section 3.4 (p. 939).

3.2 Advisory Committees

The primary function of the committee is to advise the student in all aspects of the educational program and to monitor and evaluate progress toward and completion of the degree. Thus, the committee must be active throughout students' programs, beginning with helping students prepare their Plans of Work. The committee should provide an intellectually stimulating foundation for the student's professional as well as scholarly development and should be sensitive to any difficulties in the student's progress. The committee certifies whether the student has met NC State's standards for a graduate degree. Advising and guiding the student on how best to fulfill the degree requirements is a critical element of this responsibility.

It is the students' responsibility, in consultation with their graduate advisors, to select graduate advisory committees. The graduate advisor(s) serves as chair or co-chair of the committee. The Director of Graduate Programs approves and electronically submits the advisory committee names to the Graduate School for final approval as part of the Plan of Work.

A. Advisory Committee Requirement and Composition

1. Committee administrative structure
   a. Every committee shall have a chair or co-chairs.
   b. The co-chair designation implies equally shared responsibilities in guiding the student through to degree completion.
2. Master's students
   a. For master's students in all programs except Option B, the committee consists of a minimum of three graduate faculty members, inclusive of the committee chair. The Graduate School verifies the committee when the DGP submits the Plan of Work that includes the committee information.
   b. If a minor has not been declared, it is up to the individual program whether to require external representation on the committee.
   c. If a minor has been declared, one member of the committee must be from the minor field.
   d. In a master's program in which the minor is classified as interdisciplinary, the minor must be represented by a committee member.
   e. Option B master's students do not have a committee. The Graduate School will verify the appropriate major advisor when the DGP submits the students' Plans of Work.
3. Doctoral students
   a. Doctoral committees require a minimum of four graduate faculty members
   b. If a doctoral graduate committee has no outside representation beyond the student's graduate program by a member of the graduate faculty, a Graduate School Representative is required. This representative is not a voting committee member.
   c. If the student has declared a minor, one of the committee members must be from the minor field.
   d. The committee membership is submitted for approval as part of the Plan of Work
   e. At the time that the committee is approved, the Graduate School appoints the Graduate School Representative (see Section 1.6 (p. 927)) to serve on the doctoral committee, if required.

B. Functions, Responsibilities and Requirements of the Advisory Committee

The chair/co-chair and the other members of the advisory committee are responsible for the following aspects of the thesis or dissertation and the associated research experience:

1. approval of the subject matter and methodology of the thesis or dissertation research;
2. approval of the organization, content, and format of the thesis or dissertation according to NC State required and optional formatting guidelines as provided in the Thesis and Dissertation Guide;
3. review of and comment on drafts of various sections of the thesis or dissertation, including:
   a. the quality of data and evidence,
   b. logical reasoning, and
   c. the editorial, linguistic and bibliographic quality;
4. evaluation of the thesis or dissertation as a basis for certification that the student has fulfilled that portion of the degree requirements for which he or she is a candidate.

For non-thesis master's degrees that require a final examination, the advisory committee is responsible for administering that exam.

C. Committee Members from Other Institutions

The selection of outside committee members will generally depend upon the student's major interest and research. If the program recommends the appointment of a committee member who is not an NC State graduate faculty member, it should be made clear to that person that he or she will be expected to participate as a full committee member.

There are three types of non-NC State faculty who may be appointed to a graduate committee: inter-institutional faculty, external (voting) members, and technical consultants.

1. Interinstitutional Graduate Faculty
   a. Graduate Faculty from UNC-CH and Duke. A member of the graduate faculty from the University of North Carolina at Chapel Hill or Duke University may serve as one of the required committee members when appropriate. These are automatic appointments, although the members are vetted by the DGP of the program, the Associate Dean of the College involved, and the Dean of the Graduate School.Members of professional programs at these institutions, such as faculty at the School of Law or Medical School at UNC or Duke, cannot serve automatically unless their appointment at their respective institution explicitly states that they are on the graduate faculty. A Graduate Advisory Committee Appointment Form for Interinstitutional Member must be completed for faculty from these institutions. Should their appointment be for that professional school only, then they must follow the guidelines discussed for External Members and/or Technical Consultants (see below).
   b. Cooperative Doctoral Program Graduate Faculty from UNC-System Institutions. In addition to the non-degree-specific interinstitutional arrangement of NC State, UNC, UNC-G and Duke, NC State has established cooperative doctoral programs with other UNC-system institutions.
2. External Members. A faculty member from another university (who is not an interinstitutional graduate faculty member) or a professional from industry or government with credentials comparable to those required for membership on the graduate faculty, may serve as an external member, in addition to the number of committee members normally required (four for doctoral degrees and three for master's degrees).
   a. Appointment. To appoint an external member, the DGP must submit a Graduate Advisory Committee Appointment Form for External Member/Technical Consultant along with the proposed external member's curriculum vitae.
   b. Responsibilities. External members will have full voting privileges and are expected to participate in the student's preliminary and final examinations. They will also be consulted in the development of the student's Plan of Graduate Work and will approve the thesis or dissertation.

3. Technical Consultants. A person from industry, a governmental agency, or a university may, upon recommendation of the committee and the DGP, serve as a technical consultant along with the required committee members.
   a. Appointment. To appoint a technical consultant, a Graduate Advisory Committee Appointment Form for External Member/ Technical Consultant must be submitted to the Graduate School, along with a statement describing the Technical Consultant's potential contribution to the student's research or project.
   b. Responsibilities. Technical consultants serve in an advisory capacity to students in the conduct of research for their dissertation, thesis or master's project. Technical consultants are expected to participate in the student's preliminary and final examinations and may sign the thesis. However, they will not vote on the outcome of the examinations.

D. Substitution of Committee Members for Exams

Under extenuating circumstances, it may be necessary for a member of a graduate advisory committee to have a substitute at committee meetings or an exam. The substitution of a committee member on an oral examination must be requested in writing by the DGP and approved by the Graduate School in advance of the examination. It is extremely important to have clear communication between committee members and substitutes so that new expectations or concerns do not arise at the time of the final oral examination.

E. Permanent Changes in Committee Members

1. Changes before Final Examinations for Master's Students and before the Preliminary Examination of PhD Students. Should students, in consultation with their advisors, wish to change any of the committee members, they must submit a revised Plan of Graduate Work with the new members, indicating that this change has been approved by the advisor and by the DGP. Approvals of the students, the committee members, and the DGP must be included. The DGP must submit the revised Plan of Work to the Graduate School.Disagreements within committees or between students and committee members over the quality of students' performance are not grounds for reconstituting the committee. If students believe that they have been unjustly or unfairly treated in efforts to resolve committee conflicts, they have the right to grieve this issue, according to the current University Grievance Procedures for Graduate Students.
2. Changes after the Preliminary Examination. Changes in doctoral committee membership after preliminary exams requires signatures of both outgoing and incoming committee members and the student, as well as justification for the committee change. Approval by the Graduate School is required before holding any examinations.

3.3 Graduate Plan of Work

A. Description

The Graduate Plan of Work is a document that serves both as a guide to successful degree completion and a contract between students and their programs. In this way, it serves to reduce the potential for misunderstandings about degree requirements and outlines the expected academic progress students should make. It is especially helpful when it is evaluated on at least an annual basis by students with their advisor(s), and, where applicable, their advisory committees, with any needed modifications recorded at that time. It should be viewed as a "living document" that reflects changes that may occur as students continue to develop and refine their academic programs.

B. Contents of a Graduate Plan of Work

At the time of final submission Graduate Plan of Work must include:

1. a list of the coursework to be undertaken
2. accurate information about any transfer credits to be used for the degree. Any request to include transfer credit should be submitted to the Graduate School prior to the start of the student's graduate program or no later than before the end of the first semester
3. the thesis or dissertation topic (except in non-thesis master's programs)
4. the name of the student's major professor
5. the members of the student's advisory committee

C. Formulation and Submission Process

The Graduate Plan of Work must be:

1. developed by the student in collaboration with his/her major professor and, where applicable, advisory committee
2. approved by the committee and the Director of the Graduate Program (DGP) or department head prior to submission to the Graduate School for approval
3. submitted online through MyPack Portal
4. evaluated by the Graduate School, which will inform the program as to whether or not the Graduate Plan of Work meets the Graduate School requirements. The Graduate School will deny approval of any student's Graduate Plan of Work until all documents necessary to complete that student's permanent file are received (e.g., signed Patent Agreement, Transfer of Credit form, if applicable). If any materials are missing, the Graduate Plan of Work will be denied with the reason for the denial communicated to the DGP and the student.

D. Timing of Submission

As the Graduate Plan of Work serves as a guide to promote successful progression through a given graduate program, it is important that various components of it be completed in a timely manner. Failure to complete the various components of the Graduate Plan of Work may result in a registration hold being placed on a student's record.

1. All Graduate Students: Course Component of the Graduate Plan of Work
   - By the end of their first year, and preferably earlier than that, students in all graduate programs must submit at least a preliminary course schedule using "place holders" where necessary, defining the specific courses or, at a minimum, courses in a curricular area, including electives, required to fulfill the degree requirements for their respective degree programs.
2. Thesis Master's/Doctoral Students: Committee and Other Milestone Components of the Graduate Plan of Work
   - By the completion of 18 hours, but no later than the third term of enrollment, those graduate students enrolled in master's programs that require a thesis or in doctoral programs must submit additional elements of the Graduate Plan of Work that include the topic of their thesis/dissertation research, their committee chair(s), committee members, and estimated completion times for important milestones, such as the

preliminary and final oral examinations. Students in Option B master's programs requiring projects should also submit their topic and the name of their project advisor.

3. Submission of Final Graduate Plan of Work
    - The final version of the Graduate Plan of Work must be submitted before a master's student's final examination and before a doctoral student's preliminary oral examination. For Option B students, this should be submitted prior to the completion of their Application to Graduate in their final semester.

E. Revising a Graduate Plan of Work

The expectation is that the Graduate Plan of Work will be reviewed and revised annually to reflect students' academic trajectories as they become better defined during their academic careers. Given that an annual progress report is required (Section 3.4 (p. 939)) as part of this process, the student's major professor and, where appropriate, advisory committee should review the Graduate Plan of Work to evaluate progress, suggest potential revisions, and provide guidance as necessary.

F. Annual Progress Evaluation

The Graduate School requires all graduate programs to complete an annual evaluation of progress toward degree for each graduate student. This evaluation process should involve the student, at least one academic advisor/committee chair, and the DGP. As part of each annual evaluation, the student's major advisor should review the POW to evaluate progress, suggest potential revisions, and provide guidance as appropriate. Each evaluation must include the following items:

1. the student's report of activities and achievements for the preceding year (e.g., courses, honors, milestones achieved, and professional development);
2. the student's own evaluation of his or her progress;
3. an evaluative response to the student's progress report by at least one faculty advisor/committee chair; and
4. a completed POW (see POW requirements).

3.4 Time Limits

A. Master's Degrees

Students must complete all requirements for the master's degree within six calendar years. The student's degree clock for time to completion starts with the first course approved for inclusion in the plan of work or the date of admission to the program, whichever comes first. The time limit remains at six years even if a student was on approved leave of absence during the six-year period.

B. Doctoral Degrees

All doctoral students must complete all degree requirements within ten calendar years; for information about the time limits for completing the preliminary oral examination, see Section 3.5 (p. 939). The time limit remains at ten years even if a student was on approved leave of absence during the ten-year period. The student's degree clock for time-to-completion starts with the first course approved for inclusion in the Plan of Work or the date of admission to the program, whichever occurred earlier. Academic colleges/schools or programs may have more restrictive requirements than the above stated University policy.

C. Time-Limit Extensions

The Graduate School may grant exception to the above time limits for a period of up to two years, which can include, but is not limited to: military obligations, family and medical circumstances, and life events. The Dean, or designee, will consider and evaluate the specific nature of the circumstances, the reasons that prompted the advisor and DGP to make the request, the impact the proposed extension would have on the validity of coursework and research, as well as a detailed timeline outlining how and when various degree requirements completed (see Time Limit Extension form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/)).

For requests beyond two years, the Graduate School will undertake an initial review to determine if they should go forward. If a positive decision is reached, such appeals must be presented to the Administrative Board of the Graduate School by the advisor or their designee. That body will render decision as to whether or not the request should be granted.

3.5 Comprehensive Examinations

Comprehensive examinations are a critical step in degree completion in evaluating the relevant breadth of knowledge in master's and doctoral students. Throughout the process, the chair of the candidate's advisory committee has the obligation to maintain a scholarly atmosphere and to keep academic integrity and the student's best interest foremost.

A. Doctoral Students

- Doctoral students schedule their oral preliminary and final examinations in consultation with their advisory committees. It is the responsibility of doctoral students to contact committee members and, where appropriate, the appointed Graduate School Representative to establish a date and time convenient to all members before officially requesting that the examination be scheduled. The Graduate School, upon approval, will send notification of the exam date to the committee and Graduate Representative. For both preliminary and final oral examinations, the Graduate School requires that DGPs submit a Request to Schedule Doctoral Oral Examination form 10 working days prior to the proposed exam date. The 10-day window does not commence until all other requirements are completed, including a final, approved Plan of Work and a Patent Agreement.
- Two weeks prior to the final examination, the student must also provide the committee with a copy of the dissertation. This deadline may be earlier in cases that involve research directly funded by a company (see Section 3.7 – Theses and Dissertations)

B. Master's Degree

1. Written examinations (Optional)
    - A degree program may require written examinations covering the subject matter of the major and the minor in which the student is enrolled. When required, such examinations must be successfully completed prior to the submission of a Request for a Permit to Schedule the Master's Oral Examination. Information concerning written examination schedules should be obtained from the student's program.
2. Oral examinations
    - Candidates for master's degrees (except those in Option B programs) must pass a comprehensive oral examination to demonstrate to the advisory committee that they possess a reasonable mastery of the subject matter of the major and minor

fields and that this knowledge can be used with promptness and accuracy.

a. Scheduling an exam – Master's students schedule their oral examinations in consultation with their advisory committees. To do this, students must submit a Request for a Permit to Schedule the Master's Oral Examination to their DGPs who approve and submit it to the Graduate School two weeks prior to the date of the examination. The two-week window does not commence until all other requirements are completed, including a final, approved Plan of Work and a Patent Agreement.

b. Format of the exam – This exam takes the form of a traditional thesis defense in those programs requiring theses. This examination may not be held until all other requirements, except completion of the coursework taken during the final semester, are satisfied. After obtaining DGP approval, a student must file a Request to Schedule Master's Oral Examination with the Dean of the Graduate School only after the above conditions are met. For students in non-thesis, non-Option B master's, the program determines the format of the oral exam.

c. Passing the oral examination – Within a week of completing the exam, the student's DGP must forward a permit form (Admission to the Final Master's Oral Examination) that displays the date that the exam was conducted, the result of the examination, and the signatures of all advisory committee members to the Graduate School. A unanimous vote of approval of the advisory committee is required for passing the oral examination.

d. Conditional pass – Students may get a conditional pass contingent upon completion of additional work to the satisfaction of the advisory committee. A formal re-examination may not be required in this case. The DGP must notify the Graduate School within a week after the exam of the conditional pass, the reasons for the conditional pass, and also when the conditions have been removed. The date upon which the Graduate School is notified of the pass establishes the student's graduation date.

e. Failure to pass the oral examination – A student who fails the oral examination is terminated from graduate work at NC State unless the graduate advisory committee unanimously requests a re-examination. Only a single re-examination will be allowed. If the DGP or the Graduate School denies the request, the student's program is terminated.

C. Doctoral Degree

1. Preliminary written examinations
   - Each doctoral student is required to take a preliminary examination, consisting of written and oral components, after they have completed their coursework. As indicated in Section 3.4, all doctoral students must attain candidacy for the degree within four years of starting their program or after they have completed 48 hours of coursework, whichever is later.

   a. Format of the exam. The written portion of the examination may be conducted in one of two ways.
      - If applicable, the written portion of the examination may be conducted in one of two ways.
      - The committee decides on the specific format of this exam, and each member of the advisory committee prepares a set of questions for the student's response, and the answers to each set are returned to the appropriate faculty member for evaluation.
      - Standardized departmental examinations may be used for all students in a program. These examinations are given at specified times during the year, and scheduled dates must be announced at least a semester in advance. Where written departmental examinations of this kind are used, the student will be expected to notify the department of their intent to sit for this examination. Regardless of which method is employed, the questions involved may cover any phase of the coursework taken by the student during graduate study or any subject logically related to an understanding of the subject matter in the major and minor areas of study. The questions are designed to measure the student's mastery of his/her field and the adequacy of preparation for research.

   b. Notification of completion. Committee chair(s) must notify the DGP when a student has completed the written examination.

2. Preliminary oral examinations
   - The oral examination is designed to test the student's ability to relate factual knowledge to specific circumstances, to use this knowledge with accuracy and promptness and to demonstrate a comprehensive understanding of the field of specialization and related areas.
   - Upon satisfactory completion of the written portion of the preliminary examination, the DGP must submit a Request to Schedule the Doctoral Oral Examination to schedule the preliminary oral examination. If the Graduate School Representative has already been assigned to the student's committee, then the Graduate School will respond to the request within one week of its receipt. If the Graduate School Representative has yet to be assigned, the Graduate School may take up to two weeks to respond to the request.
   - After the Graduate School has approved the scheduling of the preliminary oral examination, the signed and dated request form is emailed to the committee chair, committee members, Graduate School Representative, and graduate student listed on the form.

   a. Format of the examination. Though the format of the oral preliminary examination may vary according to the culture of individual graduate programs, as a general guideline such examinations generally include the following three elements.
      - Presentation by the candidate. The candidate makes a presentation of a research proposal. This presentation may be open if the program wishes it to be, but NC State graduate faculty may not be excluded, and the committee chair or Graduate School Representative can restrict the session to all but graduate faculty as deemed necessary.
      - Questioning of the candidate. Anyone attending the presentation will be allowed to ask questions of the candidate at the conclusion of the presentation.
      - Deliberation and decision. Only the advisory committee and the Graduate School Representative, if one has been appointed, will be allowed to participate in the deliberation and decision."

   b. Outcomes
      - Passing the preliminary examination. A unanimous vote of approval of the advisory committee is required for passing the preliminary examination. Approval may be conditional, however, and require students to meet specific requirements prescribed by their advisory committee. These conditions must be written in a clear and distinct way and communicated in such a manner that the student clearly understands what is expected; they must also be submitted to the DGP and the Graduate School.

- Failure to pass the preliminary examination. A student who fails the preliminary examination is terminated from graduate work at NC State unless the graduate advisory committee unanimously requests a re-examination. Only a single re-examination will be allowed; it can encompass written, oral, or both components as determined by the advisory committee. If the DGP or the Graduate School denies the request, the student's program is terminated.

3. Candidacy
   - A doctoral student is admitted to candidacy by the Graduate School upon successfully passing the preliminary examinations. This does not include students receiving a conditional pass.
4. Final Oral Examination
   - As with the preliminary oral examination, the chair of the student's advisory committee oversees the final oral examination. Students in consultation with their advisors submit a Request to Schedule the Doctoral Oral Examination to their DGP, indicating that they wish to schedule the final oral examination.
   - The final oral examination is scheduled after the dissertation is complete except for such revisions as may be necessary as a result of the examination, but not before all required coursework has been completed.
   - After the Graduate School has approved the scheduling of the final oral examination, the signed and dated request form is emailed to the committee chair, committee members, Graduate School Representative, and graduate student listed on the form. A file copy of the approved request form will be sent to the DGP.
   - The student should be sure to include the most current title of the dissertation, as the Graduate School mails information about the scheduled examination to the NC State Official Bulletin for publication.

   a. Format of final examination. Though the format of the doctoral examination may vary according to the culture of individual graduate programs, all examinations include three elements:
      - Presentation by the candidate. The candidate typically presents the methodology used, the data collected, and the conclusions reached as reported in the dissertation. For the purpose of dissemination of research, it is required that the presentation of the dissertation be open to the university community.
      - Questioning of the candidate. Any member of the university community is allowed to ask questions of the candidate. The questioning phase may continue with a closed session in which the advisory committee questions the candidate.
      - Deliberation and decision. Only the advisory committee and the Graduate School Representative are present.Throughout the process, the chair of the candidate's advisory committee has the obligation to maintain a scholarly atmosphere and to keep academic integrity and the student's best interest foremost.

   b. Outcome of final examination
      - Passing the final oral examination. A unanimous vote of approval of the advisory committee is required to pass the final oral examination. In the case of a conditional pass, the specific requirements must be submitted to the student as well as the Graduate School attached to the Exam Results form. Final approval by the advisory committee is dependent upon a student's successful completion of those conditions.
      - Failure to pass the final oral examination. Should a student fail the final examination, this terminates a student's academic program unless the advisory committee recommends a re-examination.

D. Format for Remote Oral Exams

It is expected that oral examinations be conducted with all parties in the same room; however, it is recognized that circumstances may prevent this from happening. While technology can provide solutions for such situations, it should never be the case that remote exams are held simply as a matter of convenience. The student and major professor or at least a co-chair must be present in person.

When members attend examinations remotely, it is the responsibility of the chair of the committee to maintain the academic integrity of the exam and to ensure that the spirit of the requirements outlined in 3.6.B or 3.6.C above are followed. The technology used must allow all parties to interact visually and aurally to accomplish this. Failure of the technology during the exam will require that the exam be suspended until it is in functioning order or rescheduled for a later time.

It is the DGP's responsibility to ensure that the reasons for a remote exam are valid and to submit a request to conduct the exam to the Graduate School in conjunction with the Request for a Permit to Schedule the Master's or Doctoral Oral Examination.

3.6 Theses and Dissertations

A. Theses

In degree programs requiring preparation of a thesis, master's students must undertake an original investigation into a subject that has been approved by the student's advisory committee. All theses must be submitted in accordance with the Electronic Thesis and Dissertation (ETD) Guide (https://grad.ncsu.edu/students/etd/). Theses should be submitted to the advisory committees at least two weeks prior to the final defense.

B. Dissertations

The doctoral dissertation must present the results of the student's original investigation in the field of primary interest. It must represent a contribution to knowledge, adequately supported by data, and be written in a manner consistent with the highest standards of scholarship. All dissertations must be submitted in accordance with the ETD Guide. Publication is expected and encouraged. Dissertations should be submitted to the advisory committees at least two weeks prior to the final defense.

C. Company-Funded Research

For thesis or dissertation research that is funded by a company, students and their advisors must ensure that there is a clear agreement as to the ability to place the results in an ETD and, should there be proprietary information, that a mechanism be in place to ensure that the ETD remains viable. Furthermore, if a company's requires approval of the document prior to a defense, this will require additional lead time to insure that only the appropriate information is included.

D. Submission Procedures for Theses and Dissertations

1. All advisory committee members must approve the thesis/dissertation prior to submission to the library for publication.

2. After receiving an unconditional pass on the final oral exam, the student must submit the thesis/dissertation electronically to the ETD system.
3. A thesis/dissertation must be submitted by the ETD deadlines as published in the Graduate School Calendar.
4. At the time of dissertation submission, students are also required to submit the required forms and fee as outlined on the ETD website. The Graduate School will not award the degree until these forms and fees have been submitted.

E. Publication in Compliance with Nondisclosure Provisions

Theses and dissertations containing disclosures of patentable discoveries may be embargoed by submitting a request through the ETD system. They may be granted for up to one year. Placing an embargo on a thesis or dissertation until a patent application is filed will not prevent a student from graduating on time.

3.7 Master's Degree: Summary of Procedures

A. Requirements for All Master’s Degree Students

1. Application materials and required fees received.
2. Application materials reviewed by graduate program.
3. Graduate program forwards recommendation regarding applicant’s admissibility to the Dean of the Graduate School.
4. The Dean of the Graduate School reviews the recommendation and the student is notified of the action taken on the request for admission.
5. Outstanding transcripts, if any, showing any or all post-secondary coursework attempted and degree(s) conferred since application should be submitted by student to the Graduate School, prior to matriculation.
6. Student arrives, reports to the graduate program, is assigned a graduate advisor and develops a roster of courses and credits with the advisor.
7. Student subject to continuous registration policy until graduation.
8. Student approves Patent Agreement via Student Self-Service in the MyPack portal.
9. Student develops a Plan of Graduate Work in consultation with and the approval of his/her graduate advisor and Director of Graduate Programs (DGP). The Plan of Work must be submitted via SIS to the Graduate School where graduate records staff will review it and advise the program of any changes that need to be made before the Request for a Permit to Schedule the Master’s Oral Examination (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) or the Graduation application can be approved by the Graduate School.
10. Student passes language examination, if required.
11. Student passes written examination, if required.
12. Student must Apply to Graduate in MyPack Portal by the “apply to graduate deadline” in the term in which they plan to graduate.
13. A GPA of at least 3.000 for the degree requirements as well as on overall graduate course work at NC State is required for graduation.
14. All degree requirements must be completed within six calendar years, beginning with the date the student takes courses carrying graduate credit applicable to the degree program, unless a more restrictive time limit has been established by the program or academic college/school.

B. Option B Programs

The student must Apply to Graduate via MyPack Portal and the DGP set the Graduation Approval page to “Departmental Review Complete” no later than the “apply to graduate deadline” for the term in which the student anticipates graduation. The deadline appears in the Graduate School Calendar (https://grad.ncsu.edu/events/).

C. Master’s of Discipline or Non-thesis Programs (excluding Option B)

1. Graduate advisory committee of three or more Graduate Faculty members is appointed by the DGP.
2. When all requirements except completion of the course work in the final semester are satisfied, DGP submits to the Graduate School the Request for a Permit to Schedule the Master’s Oral Examination.
3. If Graduate School requirements are met, a Request for a Permit to Schedule the Master’s Oral Examination is approved by the Graduate School within 10 working days of receipt of the request and the permit, Admission to the Final Master’s Oral Examination, is issued.
4. Final examination is scheduled and conducted.
5. Final examination report, including date and result of the examination, submitted to the Graduate School by the DGP. The Graduate School should receive the report within five working days of the examination.
6. The deadline date for unconditionally passing the final examination in order for the student to graduate in a given semester or summer session appears in the Graduate School Calendar.

D. Thesis Programs

1. Graduate advisory committee of three or more Graduate Faculty members is appointed by the DGP.
2. A preliminary copy of the thesis is submitted to the chair of the student’s advisory committee.
3. When all requirements except completion of the course work in the final semester are satisfied and after the thesis is complete except for such revisions as may be necessary as a result of the exam, the DGP submits to the Graduate School the Request for a Permit to Schedule the Master’s Oral Examination.
4. If Graduate School requirements are met, the Request for a Permit to Schedule the Master’s Oral Examination is approved by the Graduate School within 10 working days of receipt of the request, and the permit, Admission to the Final Master’s Oral Examination, is issued.
5. At least two weeks prior to the final oral examination, the chair of the student’s advisory committee submits the thesis, if required, to the other members of the advisory committee for review.
6. Final examination is scheduled and conducted.
7. The Admission to the Final Master’s Oral Examination form is completed by the committee members, including date and result, and submitted to the Graduate School by the DGP. The Graduate School should receive the report within five working days of the examination.
8. Student submits the required PDF file into the Electronic Thesis and Dissertation (https://grad.ncsu.edu/students/etd/) (ETD) Submission System for the thesis review within 24 hours of passing the defense.

The date the student properly submits the required PDF file into the ETD Submission System is the date of the thesis review.

9. The deadline for submitting the thesis to the Graduate School in order for the student to graduate in a given semester or summer session appears in the Graduate School Calendar.
10. The thesis is reviewed by the Graduate School to ensure that the format conforms to the specifications prescribed in the Thesis and Dissertation Guide.
11. The thesis must then be approved by the advisory committee members prior to publication by the library.

3.8 Doctoral Degree: Summary of Requirements

1. Application materials and required fees received.
2. Application materials reviewed by graduate program.
3. Graduate program forwards recommendation regarding applicant's admissibility to the Graduate School.
4. The Graduate School reviews the recommendation and the student is notified of the action taken on the request for admission.
5. Outstanding official transcripts, if any, showing any or all post-secondary degrees conferred since application should be submitted by student to the Graduate School prior to matriculation.
6. Student matriculates, is assigned a graduate advisor, and develops a Plan of Work with the advisor/DGP.
7. Student submits online Patent Agreement through Student Self-Service in MyPack Portal.
8. Student formulates an advisory committees of at least four members of the Graduate Faculty. The Graduate School also selects a Graduate School Representative, if required.
9. Plan of Work is prepared by the student in consultation with the advisory committee.
10. Preliminary oral examinations in the major and, where required, minor fields are scheduled. The results are sent to the Graduate School.
11. At least two weeks prior to the final oral examination, the chair of the student's advisory committee submits the dissertation to advisory committee members for review.
12. The chair submits, through the DGP, the request to the Graduate School to Schedule the Doctoral Oral Examination (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) at least two weeks prior to the examination. Upon approval of the request, the student and the examining committee, including the Graduate School Representative are notified of the time and place of the examination.
13. Students must submit their dissertation to the ETD System. Deadlines appear in the Graduate School Calendar. In addition, they must submit all required forms and fees prior to final approval.
14. Student must apply to graduate in MyPack Portal by the deadline in the term in which they plan to graduate to be placed on the graduation list, have their name printed in the graduation program, have the diploma ordered, and the transcript posted.
15. All coursework scheduled in a graduate degree classification must be completed prior to graduation.
16. The cumulative and program GPA must be at least 3.000 to graduate.
17. All degree requirements must be completed within ten calendar years of the admission term or the date of the first course used in the Plan of Work, whichever is earlier, unless a program has a more restrictive time limit.

3.9 Change in Degree Level or Program

Graduate students in good academic standing may change their degree level or degree program after the completion of one semester.

A. Requirements for Changing Degree Level/Program

1. Graduate students are not required to re- apply to change their degree level or program.
2. Students must consult with their advisors and current Director of Graduate Programs (DGP).
3. The student must sign a Request for Change of Degree Status or Curriculum form and submit it to the DGP of the program in which the student is currently enrolled.
4. No change in level/program will be effective without the approval of:
   a. the DGP of the program in which the student is currently enrolled;
   b. the DGP of the new program into which the student is requesting transfer; and
   c. the Graduate School. Upon approval of the request, the Graduate School will notify both departments, where applicable, and transfer the student's records to the appropriate department.

B. Final Semester Transfers

If students request a change in degree level/program in their final semester, the deadline for submission is six weeks after the first day of classes in that semester.

C. Process for International Students

International students who have had a degree level/program approved must obtain a new I-20 from the Office of International Services (https://internationalservices.ncsu.edu/). The U.S. Citizenship and Immigration Services (https://www.uscis.gov/) requires a new visa when an academic program changes.

3.10 Dual Master's Degrees

Students enrolled in a master's degree program at NC State University may pursue additional master's degrees simultaneously provided that:

1. the Director of Graduate Programs (DGP) of each program approves the pursuit of multiple degrees;
2. an approved Plan of Work for each master's degree is submitted;
3. 18 hours are unique to each degree program; and
4. all other requirements and Graduate School rules are met for each degree;
5. the time limits in place for the initial degree apply to all others.

3.11 Master's Degrees while in Doctoral Status

A. Master’s Degrees in the Same Field as the Doctoral Degree

Students admitted to doctoral programs at NC State may be awarded a master’s degree in the same field as the doctoral program provided that all of the following conditions are satisfied:

1. The student does not already have a master’s degree in the same field.
2. All Graduate School, College, and Department/Program requirements for the master’s degree are satisfied.
3. The graduate program may require students to transfer into the master’s program from the doctoral program (or other master’s). Once a doctoral student is transferred into a master’s program, the student must complete the requirements for the master’s degree before returning to the doctoral program.
4. All requirements must be completed before the six-year time limit for master’s degrees.
5. The minimum of 72 credit hours required for the doctoral degree is met, including the credits used for the master’s degree.
6. International doctoral students who wish to obtain a master’s degree in a different program from their doctoral program with the intention of applying for Optional Practical Training in the field of the master’s curriculum must transfer to the new curriculum at the master’s level to be eligible for this training.
    - International doctoral graduate students must communicate their intentions to the DGP in each department as well as to the Office of International Services (OIS). Failure to do so could result in a violation of non-immigrant status and subsequent ineligibility for any type of employment.
    - Students in F-1 status who transfer to a new master’s program must obtain new I-20.

B. Master’s Degree in a Different Field from the Doctoral Degree

Graduate programs have the option of making their master’s degrees available to students pursuing doctoral degrees in other programs without the students transferring to the master’s program. For doctoral students to get degrees in master’s programs, the following conditions must be satisfied.

1. The student may not have a master’s degree or a doctorate in the field of the proposed master’s.
2. The student’s request must be approved by the DGP of the student’s doctoral program, the DGP of the proposed master’s program, and the Graduate School.
3. The student must make satisfactory academic progress toward the fulfillment of the doctoral degree requirements as outlined in the doctoral Plan of Work (this may consist only of doctoral research credits). Such students are limited to six credit hours per semester towards the master’s degree.
4. A minimum of 72 credit hours is required for the doctoral degree, including the credits used for a master’s degree at NC State University in the same field. The maximum number of credit hours that can be used from master’s level work is 36.
5. All Graduate School, College and Department/Program requirements for the master’s degree must be satisfied.
6. International doctoral students who wish to obtain a master’s degree in a different program from their doctoral program with the intention of applying for Optional Practical Training in the field of the master’s curriculum must transfer to the new curriculum at the master’s level to be eligible for this training.
    - International doctoral graduate students must communicate their intentions to the DGP in each department as well as to the Office of International Services (OIS). Failure to do so could result in a violation of non-immigrant status and subsequent ineligibility for any type of employment.
    - Students in F-1 status who transfer to a new master’s program must obtain new I-20.
7. In rare instances where a student wishes to enroll in more than one master’s program while enrolled in doctoral status, they must consult with the DGPs of the relevant programs and to be approved requires the documentation presented above.

C. Credit-Hour Requirements for Master’s Degrees while in Doctoral Status

1. A minimum of 18 hours must be unique to each master’s degree, but up to 36 hours can be shared with the doctoral program.
2. Combining credit hours from two or more master’s degrees is not permitted to satisfy the total doctoral credit hour requirement; i.e. courses from the master’s degrees are not additive.

D. Completion of Master’s Degree Requirements while in Doctoral Status

1. The DGP for the master’s program must notify the Graduate School that the student has met, or will meet in the current semester, the requirements for the master’s degree by submitting:
    - a Plan of Work for that degree,
    - an approved patent agreement (via Student Self-Service in MyPack Portal) that includes the names of the members of the master’s advisory committee (or advisor for Option B programs), and
    - a Plan of Work or a list of courses that are to be used to satisfy the master’s requirements.
2. It is the responsibility of the student to meet all deadlines for graduation with a master’s degree. The master’s degree should be awarded when the degree requirements are fulfilled.

E. Eligibility for Graduate Student Support Plan Tuition Support

The number of semesters of eligibility for tuition support under the Graduate Student Support Plan does not change as a result of the student’s electing to pursue a master’s degree in another program along the way to the Ph.D. The Graduate School maintains current online information and requirements for the Graduate Student Support Plan (https://grad.ncsu.edu/students/gssp/).

3.11a Co-Majors and Minors

Co-Majors

Graduate students wishing to co-major must obtain approval from both programs. Co-majors must meet all requirements for majors in both

programs. A representative from each program must also be included on the student's advisory committee. A student may not co-major in two different degree levels, i.e. a master's in one discipline and a doctoral in another.

One degree is awarded and the co-major is noted on the transcript. Enrolled co-majors will be classified in only one program for record purposes. *[Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 9/23/93.]*

1. Master's Students: Students may co-major at the master's level in programs with identical degrees, although the degrees do not necessarily have to have identical requirements (e.g., two Master of Science programs, one with a thesis requirement and one without). No student is required to declare a minor.
2. Doctoral Students: Students may co-major at the doctoral level with the approval of both programs and with the appointment of a co-chair from each program on the advisory committee. The co-chairs will have equal responsibilities for directing and mentoring the student (see Section 3.2 Advisory Committees, A.1.c). Co-majors are not permitted between Doctor of Philosophy and Doctor of Education degree programs.

Minors

The Graduate School does not require a minor, although individual programs may require one. If a program does not require a minor, the graduate student has the option of choosing one, except in an Option B master's program in which a minor is not allowed. The minor work will usually be from a single discipline or field that in the judgment of the advisory committee provides relevant support to the major field. However, the committee has the alternative of developing an interdisciplinary minor if it best serves the needs of the student. *[Recommended by the Administrative Board of the Graduate School and approved by the Dean of the Graduate School on 12/12/91.]*

When a student selects a minor, the advisory committee must include a representative from the minor field. The minor credits on the Plan of Graduate Work must be approved by the graduate advisory committee member representing the minor, and, in some cases, the Director of Graduate Programs (DGP) from the minor program.

Minors That Require Approval of DGP of Minor Program

Students wishing to minor in Biotechnology, Plant Physiology, Statistics, and Water Resources, must obtain the approval from the respective DGP.

1. Doctoral Students: For doctoral students, this approval must be obtained from the minor field's DGP and then indicated on the Plan of Graduate Work submitted after the completion of 12 graduate hours at NC State.
2. Master's Students: For master's students, this approval must be obtained from the minor field's DGP at the onset of course work in the minor field so that they are able to meet any specific requirements in that minor well before the time they wish to schedule their final oral examination.

3.12 Accelerated Bachelor's/ Master's Program

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the bachelor's and master's degrees at an accelerated pace. These undergraduate students may double count up to 12 graduate-level credits (500 or 700 level) and obtain a master's degree within 12 months of completing the bachelor's degree.

ABMs provides an opportunity for the Directors of Graduate Programs (DGPs) to recruit rising juniors to their graduate programs. However, approval to pursue an ABM degree program does not guarantee an admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

A. Creating an Accelerated Bachelor's/ Master's Program

There are two options for creating ABM programs. The first option is a disciplinary model in which a bachelor's program and a master's program in the same department or in departments of closely related disciplines establish an ABM degree. Prior to admission of any student into such a degree program, the program must be developed by the undergraduate and graduate units and approved by the associated college(s) Deans, the Administrative Board of the Graduate School, and the Dean of the Graduate School.

The other option is an individualized model in which a student is in a department that has not established a formal ABM program or is in a department in one discipline and wants to pursue a master's degree in a different discipline. For this option, an ABM arrangement must be made between the student and the Director of Graduate Programs the graduate degree program and must be approved by the coordinator of the undergraduate program in which students are obtaining their bachelor's. The Director of Graduate Program must recommend admission to the Graduate School and this must be approved by the Dean of the Graduate School.

B. Student Eligibility Requirements

1. Students may apply once they have completed a minimum of seventy-five credit hours in their undergraduate programs, including credits earned from advanced placement, but prior to the completion of their bachelor's.
2. Transfer students must have completed a minimum of 24 hours as a full-time student at NC State.
3. Students must have a minimum overall undergraduate grade point average (GPA) of 3.500 at NC State at the time of admission into the ABM program. This GPA must be maintained throughout their undergraduate program to remain in an ABM program.
4. Students must receive a grade of B or better in the double counted graduate-level courses (500 or 700 level) while maintaining a 3.500 GPA. Courses with a grade of B- or below cannot be double counted between the two degrees.
5. If students' undergraduate GPAs drop below 3.500, the DGP must inform the directors of their undergraduate programs and the students in writing of their ineligibility. A copy of this letter must also be sent to the Graduate School.

6. A student who is ineligible to participate in or withdraws from the ABM program, cannot double count any courses for both bachelor's and master's degrees.
7. Students in the ABM must receive the bachelor's degree prior to entering graduate status.

C. Application to the Accelerated Bachelor's/Master's Program

1. Interested students that meet the GPA requirement should schedule a meeting with their Directors of Undergraduate and Graduate Programs to develop tentative academic plans for the bachelor's and master's degree programs. The Graduate School requires an approved ABM Plan of Work form to admit a student into an ABM program. The ABM Plan of Graduate Work should clearly indicate:
   - the courses (a maximum of 12 graduate credit hours, 500 or 700 level) that will be double counted for both bachelor's and master's degrees,
   - the courses that will be taken after matriculating into the graduate program,
   - the graduation date for the master's degree that meets the time limit for the ABM program.
2. While still an undergraduate, students must submit the standard application for admission to the Graduate School including an application fee and other documents/standardized test scores required by individual programs.
3. Any deviations from the approved ABM Plan of Work form, require that the updates be approved by the Directors of Undergraduate and Graduate Programs as well as the Graduate School.

D. Withdrawal

Student may withdraw at any time from an ABM program by informing the Directors of Undergraduate and Graduate programs in writing. A copy of this request must also be sent to the Graduate School.

3.13 Graduate Certificate Programs

A. Definition

A Graduate Certificate Program (GCP) is a prescribed set of related graduate-level academic courses, designed by an academic department or program. To receive a certificate, non-degree-seeking students must submit an application and fee through the Graduate School and obtain admission, whereas enrolled graduate students are required to submit the Graduate Certificate Plan Entry form. Certificates cannot be conferred retroactively for students not continuously enrolled in a graduate degree program when the required coursework was completed. Upon completion, the GCP will be designated on the student's transcript and the student shall receive a certificate from Registration and Records entitled "Graduate Certificate in…." Students enrolled in graduate certificate programs may be eligible for federal financial aid. Contact the Financial Aid Office (https://online-distance.ncsu.edu/cost/financial-aid/) for more information.

B. Minimum Requirements for Graduate Certificate Programs

1. All students enrolled in a GCP must have a bachelor's degree from a regionally accredited institution of higher education; the transcript of this degree indicating conferral date must be submitted to the Graduate School.
2. All GCP coursework must be taken at NC State. **Transfer credit from other institutions is not allowed.**
3. The minimum number of credits required for a GCP is 12.
4. For most GCP, required courses must be regular graduate-level academic courses; 400-level courses may only be used for those certificates where a course at that level has been approved by the Administrative Board as part of the GCP's approval process.
5. All courses should be letter graded, although three credits of S/U-graded coursework can be used where the courses are relevant to the certificate and S/U is the only grading option.
6. GCP students do not have the option of taking the courses for "credit only" if they intend for the course to be part of their GCP.
7. To receive a Graduate Certificate, a student must have a minimum 3.000 grade point average (GPA) on all certificate coursework. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA.
8. A minimum grade of a C- is required to receive certificate credit for a course, although departments/programs may require a higher minimum and the overall GPA requirement must still be maintained.
9. GCPs must be completed within four years, beginning with the date the student commences courses applicable to the GCP, unless a more restrictive time limit has been established by the program or academic college/school.
10. Students can obtain multiple certificates from NC State. Each certificate must have at least nine credit hours that are unique to it; see Section C for certificates taken by students in a degree program.

C. Graduate Certificates and Graduate Degree Program

1. Internal and Shared Credit
   a. Graduate certificate courses taken while enrolled in a degree program may be double-counted with the degree courses to the extent that the courses unique to the degree remains eighteen hours for a master's or thirty-six hours for a doctorate.
   b. Interinstitutional courses count as NC State courses.
   c. Certificate and graduate minor coursework shall not be shared, i.e., a student getting a minor using a set of coursework may not also get a certificate using that same coursework.
2. Transferring Certificate Coursework into a Degree Program
   a. Up to 12 hours of certificate credit taken prior to enrollment in an NC State master's or doctoral degree program may be transferred into that degree program so long as eighteen hours remain unique to the master's and thirty-six hours to the doctorate.

3.14 Minimum Enrollment Requirements

A. Requirements of Continuous Enrollment

After students are admitted to the Graduate School and enroll for the first time, they are required to maintain continuous enrollment. This mandates that students enroll each Fall and Spring semester, excluding Summer terms, until they graduate. Failure to maintain continuous enrollment results in termination of academic program. To re-enroll following

termination, students must reapply for admission, pay the admission fee, and be granted admission by the program and the Graduate School (see Readmission, Section 2.3 (p. 930))

Exceptions

1. Leave of Absence
   Students who must interrupt their enrollment may, with a strong justification, request a leave of absence from graduate study for up to two semesters within a given graduate degree program. Students should initiate the request with their advisor and have it approved by their DGP before its submission to the Graduate School. The time spent on an approved leave of absence will be included in a degree's time limit; i.e., the degree "clock" does not stop, nor is it reset.
2. Withdrawal
   - Withdrawal prior to Census. An approved Leave of Absence is required of any graduate student who withdraws prior to Census.
   - Withdrawing after Census. Withdrawal following Census constitutes continuous enrollment; therefore, a Leave of Absence is not required.

Required Summer Enrollment

All students who take their final oral examination or submit their thesis/dissertation to the Graduate School during the Summer must be registered for at least one of the two summer sessions.

No Registration Requirement related to ETD Submission

To be eligible for no registration, students must have been registered in the preceding semester or Summer term. Furthermore, they must have unconditionally passed their final oral exam and submitted their ETD for review prior to the first day of a subsequent term (inclusive of Summer) are not required to register for that semester/term (see the Table below for more details).

Term Enrolled	Last Date for ETD Submission	No-Registration Semester[1]
Fall	The last business day prior to the start of Spring semester	Spring
Spring	The last business day prior to the start of the first Summer term	Summer (either I or II)
Summer I or II	The last business day prior to the start of the Fall term	Fall

*If students do not complete the ETD process by the term denoted here, they will be required to register for additional coursework to graduate.

Graduation without Registration

Students who complete all degree requirements prior to the first day of the Fall or Spring semester or the first Summer term may graduate during the next semester or Summer term without being registered provided:

1. they were registered in the immediately preceding semester or summer session; and
2. they apply to graduate during that subsequent term.

Students whose only remaining requirement for graduation is removal of an "IN" (Incomplete) grade are not required to be registered in the following semester or term to complete the work and graduate; however, only one registration-free semester or term is allowed. See Section 3.18 for more details.

B. Requirements for Full-/Half-Time Registration

Fall and Spring Semesters

Thesis master's or doctoral students

- Full-Time: To be full-time, students must be enrolled in at least 9 hours per semester. If they have accumulated or will accumulate sufficient hours to meet the degree requirements (a minimum of 30 and 72 for master's and doctoral degrees, respectively), they will be considered full-time until they complete their thesis or dissertation provided they enroll for at least 3 credit hours.
- Half-Time: To be half-time, students must enroll in a minimum of 4.5 but not more than 8.5 hours a semester unless they have fulfilled the hours required for program (see details above).

Master's students enrolled in a program not requiring a thesis

Master's students enrolled in plans allowing both a thesis and a non-thesis option will be classified as "non-thesis" students and subject to these rules until such time as a graduate Plan of Work designating the thesis-option is approved by the Graduate School.

- Full Time:To be full-time, students must be enrolled in at least 9 hours per semester.
- Half Time:To be half-time, students must enroll in a minimum of 4.5 but not more than 8.5 hours a semester.

International Students

The U.S. Citizenship and Immigration Services (USCIS) (https://www.uscis.gov/) requires international students on F-1 or J-1 visas to carry a full-time course of study to remain in status. Students in their final semester who have completed the minimum hours required for a degree can use the Reduced Course Load form to enroll in fewer hours.

Co-op Students

Co-op students registered for COP 500 will be considered full-time. Students registered for only COP 501 will be considered half-time.

Waiver of Hours

Graduate students who meet certain prescribed special conditions, may be certified as either a full-time or half-time in cases where they do not meet the requirements for such as outlined above. A waiver of the uniform academic load rules requires attestation on behalf of the student by their committee chair, academic advisor, or their Director of Graduate Program and approval by the University.

Summer Terms

- Graduate students are not required to register during the summer.
- Students not enrolled in the Summer maintain their access to the library, but other facilities that are funded by students fees, such as the gym and Student Health Services, cannot be accessed without paying for a summer membership.
- Students who are employed as Graduate Research Assistants, but who are not enrolled in the University during a period of at least five weeks, are subject to Social Security tax withholding. Specifically,

given Federal tax law as it relates to employment outside of student status, Social Security taxes will be withheld in June for RAs who are not registered in Summer Session I and in July for RAs who are not registered in Summer Session II. The source of funds that pays the stipend must pay the same amount of Social Security tax as is withheld from the student's paycheck during these months.

- Two special registration categories are available for Graduate Research Assistants who would not otherwise take courses in the summer: XXX 696 (Summer Thesis Research) and XXX 896 (Summer Dissertation Research), where XXX represents the course prefix of a specific department/program. Each of these courses is for 1 hour of credit, which is considered full-time enrollment for tax purposes, for the Summer and which run for 10 weeks, beginning the first day of Summer Session I and extend into Session II. Social Security taxes will not be withheld from the June or July paychecks of RAs who register for either 696 or 896.
- Please note that students who are not registered at least half time during the Summer are ineligible for Financial Aid during that period.

3.15 Course Registration

A. Graduate Course Levels

1. Graduate students typically enroll for courses at the 500 through 800 level.
2. Advanced undergraduate students may enroll in 500-level courses unless otherwise specified.
3. Only graduate or PBS students may enroll in 700- and 800-level courses.
4. A student may take up to 6 hours of 400-level courses for graduate credit provided that they are outside the student's major and the program is not at the doctoral level. No more than one 400-level course of up to 4 credit hours may be used for a graduate certificate.
5. Students may not count 900-level courses toward a graduate degree program or graduate certificate.

B. Course-Load Requirements (see Section 3.14)

C. Maximum Course Load

The maximum course load for graduate degree students is 15 credit hours in a semester and six credit hours in a summer session, although students on assistantships may have lower limits imposed by their advisors or programs. Graduate students who wish to enroll for more than 15 hours must complete a Schedule Revision form that is approved at the departmental, college, and Graduate School levels.

D. Credit-Only Course Limitations

Courses at the 500 and 700 level are letter graded and cannot be taken for "credit only."
Graduate students must take 400-level courses that are letter-graded if they intend for them to fulfill programmatic requirements.

E. Enrolling for Courses in MyPack Portal

After consulting with their advisor, students may register through MyPack Portal using their Unity ID and password. Students cannot register before their enrollment access is scheduled. If an advisor has not yet been appointed, the student should consult their DGP to determine appropriate coursework.

Course descriptions are available through the Registration and Records online Course Catalog (https://webappprd.acs.ncsu.edu/php/coursecat/directory.php).

Instructor consent is required for all practica, individual special topics or special problems courses, internships, and thesis or dissertation research.

F. Adding Courses

1. During the first week of a semester, students may add courses via MyPack Portal without permission; during the second week, course additions require instructor permission.
2. Summer courses can be added during the first two days of a session without permission and during the third and fourth days with instructor permission.
3. To add a student to a course after the Census date, a Schedule Revision Form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) is required.

G. Dropping Courses

All 500-800 level courses may be dropped through MyPack Portal without grades during the first eight weeks of a semester and during the first two weeks of a summer session. Tuition will not be refunded for any courses dropped after the Census date.

A Schedule Revision Form (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) is required to drop a course after the deadline. Late dropping of courses requires documented medical reasons or other verified evidence of hardship. Courses may not be dropped after final grades have posted.

H. Dropping Non-Traditional Courses

For courses that deviate from the regular semester/session calendars, students should refer to their class syllabus and/or contact their instructor to verify the last day to drop a course without a grade.

I. Requirements for Auditing Courses

To audit a course, graduate students must have the approval of their advisor and the course instructor. While auditors receive no course credit, they are expected to attend class. Should an instructor conclude that an auditor has failed to attend, the instructor may assign a grade of "NR" (no recognition given for an audit). Graduate students may audit one course a semester tuition free; additional audits will require tuition payment.

J. Taking Courses for Credit at Other North Carolina Institutions

Interinstitutional Registration Program

- NC State participates in an Interinstitutional Registration program. Under this agreement, NC State graduate students are permitted to register for classes on one of the other campuses as approved by their advisory committees provided those courses are not offered at NC State.
- Even though taking a course on another campus, the student is exclusively under the administrative direction of the NC State Graduate School. Enrollment for courses on other campuses will

take place on this campus following guidelines from Registration and Records. The Graduate School considers such courses part of the student's normal load and the student will be billed for the courses through the NC State University Cashier's Office. During the summer, the procedure is somewhat different in that a student must be enrolled in a least one course on the NC State campus during the same session as the requested interinstitutional registration.

- As the grading systems of University of North Carolina at Chapel Hill and Duke differ from that of NC State, grades received under Interinstitutional Registration will be converted to the NC State system. For example, "H," "P," "L, and "F" grades earned at the University of North Carolina at Chapel Hill and "E," "G," "S" and "F" grades earned at Duke University will be converted to "A," "B," "C" and "F" grades, respectively.

Cooperating Raleigh Colleges

- The Cooperating Raleigh Colleges (CRC) is a program organized for the purpose of developing and conducting cooperative educational activities among Raleigh institutions. Graduate students may enroll in courses not offered by NC State. Registration and Records maintains CRC registration procedures.
- Any NC State graduate degree student who is enrolled in at least three graduate credit hours on the NC State campus may take a course through the CRC during the Fall or Spring semester, provided that:
  - (a) the course is not taught on the NC State campus;
  - (b) the advisory committee considers the course essential; and
  - (c) the student receives prior approval from the Graduate School.
- NC State students may not register for more than a total of six credits. Grades from CRC are not used in computing a student's NC State grade point average.
- Under this agreement, regular tuition and fees are paid to NC State. Students are responsible for any special fees.

3.16 Withdrawal from the University

Degree Seeking Students

A. Terminating an Active Program

1. A student who wishes to terminate his/her graduate program must first notify his/her department or program in writing.
2. The Director of Graduate Programs (DGP) then forwards the request to the Graduate School for approval.
3. If the student is not in good standing, the student will receive a 'Termination' notation on their transcripts. If the student is in good standing, the student receives a 'Termination without prejudice' notation on their transcripts.
4. If the student has preregistered, notification to withdraw must be approved before the last day of the drop period. The student is responsible for dropping all classes for the upcoming semester.

B. Withdrawal Prior to the End of the Official Drop Period (of the semester in which currently enrolled)

1. Withdrawal prior to the end of the drop period is a release from the University for the remainder of the semester.
2. Students considering withdrawal should consult their major advisor and DGP.
3. A student who wishes to drop all courses and who has preregistered and prepaid must go through the official withdrawal process which can be found at MyPack Portal: Student Self Service > Enrollment > Term Withdrawal.
4. NC State students carrying course work at another campus under the Interinstitutional Registration Program must also contact the Department of Registration and Records to initiate the paperwork necessary for removal from the class roll at the other institution.

C. Late Withdrawals

Graduate students may receive withdrawals after the last day of the official drop period but before the end of the semester. Students considering withdrawal should consult their major advisor and DGP. A student who wishes to pursue a withdrawal must go through the official withdrawal process can be found at MyPack Portal: Student Self Service > Enrollment > Term Withdrawal. Withdrawals will be considered under one or more of the following conditions:

1. Certification by a physician of inability to continue for medical reasons. Such medical petitions are subject to review by a University physician at the Student Health Center.
2. Certification by the Counseling Center or by an independent psychiatrist or psychologist of inability to continue for psychiatric/psychological reasons. In this case, the Counseling Center reserves the right to review pertinent records and to reexamine the student if necessary before recommending withdrawal. This is to certify that:
   a. there has been a significant decrease in the student's usual level of psychological functioning, and
   b. that regaining the previous level of functioning will involve a process of sufficient academic disruption to make continuing as a student unreasonable. In this situation a "hold" may be placed on the student's readmission pending certification by the Counseling Center or independent psychologist/psychiatrist that the student has regained an appropriate level of function and can be expected to maintain that usual level of psychological competence.
3. Documentation of a personal or family hardship that adversely affected the student's academic performance in a significant way.

The DGP, Dean of the College, and the Graduate School will review the student's request, consulting with the Counseling and Student Health Centers as appropriate. Once a final decision has been rendered, the student will be notified of that decision.

D. Retroactive Withdrawals

Requests for retroactive withdrawals may be made if the semester in which the student was registered has passed. Such withdrawals will normally be for an entire semester rather than for individual courses. Students considering such withdrawals should consult their major advisor and DGP. A student who wishes to pursue a retroactive withdrawal must go through the official withdrawal process through the Counseling Center. Withdrawals will be considered under one or more of the following conditions:

1. Certification by a physician of inability to perform during the semester in question. Such medical petitions are subject to review by a University physician if a request for consultation is made by the Counseling Center.

2. Certification by the Counseling Center, or by an independent psychiatrist or psychologist, of inability to perform during the semester in question for psychiatric/psychological reasons. In this case, the Counseling Center reserves the right to review pertinent records and to reexamine the student if necessary before recommending withdrawal. The certification must show a significant decrease in the student's usual level of psychological functioning resulting in severely diminished performance.
3. Documentation of a personal or family hardship that adversely affected the student's academic performance significantly during the semester in question.

The Counseling Center will communicate their recommendation to the Dean of the College in which the student was enrolled. The Dean of the College will review the student's request and the Counseling Center's recommendation, consulting with the student's DGP if appropriate, and make a recommendation to the Graduate School. The Dean of the Graduate School will approve or deny the student's request accordingly.

E. Effect of Withdrawal on Meeting Continuous Registration Requirement

Any student enrolled in a graduate program who is registered for a given semester or summer session and withdraws during the official registration period (typically the first 10 or 5 working days of a semester or summer session, respectively) must obtain a leave of absence to meet the requirement for continuous registration. However, those students withdrawing after the official registration period ends DO NOT need to obtain a leave of absence and will be considered by the Graduate School as having met their continuous registration requirement.

F. Effect of Withdrawal on Permanent Record

Neither courses nor grades are recorded on the permanent record for students who withdraw during the regular drop period. After the last day of the official drop period withdrawals without academic penalty are approved only under exceptional circumstances. In such cases, neither courses nor grades are recorded on the permanent record.

Graduate Certificate Students

G. Withdrawal Prior to the End of the Official Drop Period

Graduate certificate students should apply for withdrawal using Student Self Service in MyPack Portal through the end of the official drop period. Apply using the navigation: SIS > Student Self Service > Enrollment > Term Withdrawal. International students or students who are receiving financial aid must use the withdrawal form noted below rather than the online process.

H. Late Withdrawal

Withdrawal after the Drop Deadline requires submission of a completed Graduate Certificate Withdrawal form to the Graduate School for approval.

I. Effect of Withdrawal on Permanent Record

Neither courses nor grades are recorded on the permanent record for students who withdraw during the regular drop period. Withdrawal after the drop deadline may result in W grades for courses in which the student is enrolled. Extenuating circumstances may justify W grades not being issued.

3.17 Grades

A. General Information

1. Evaluation of a student's performance in a particular course or section is the prerogative of the instructor responsible for that course or section. No grade assigned to a student in a particular course or section may be changed without the consent of the faculty member responsible for that course or section unless required by the result of grievnace.
2. Each faculty member who assigns grades has the responsibility to implement grading procedures that are fair and equitable, and to provide a reasonable evaluation of the student's performance in the course.
3. At the beginning of the semester, faculty must include their grading scale and how grades will be determine in each course syllabus.

B. Types of Grading Systems

Performance in 500- and 700-level courses is evaluated on a scale ranging from "A+" through "F", with a plus/minus designation if selected by the instructor. Performance in most 600- and 800-level courses is evaluated as either "S" (Satisfactory) or "U" (Unsatisfactory); these grades are not used in computing the GPA.

C. Minimum Grade Requirements for Graduate Credit

A course in which a student earns below a C- or a "U" will not be included in the minimum hours required for a given degree. Depending on the course, students may be required to repeat it.

D. Regular Grading Scale and Grade Points

The following grade points are used in the calculation of grade point averages:

Grade	Points
A+	4.333
A	4
A-	3.667
B+	3.333
B	3
B-	2.667
C+	2.333
C	2
C-	1.667
D+	1.333
D	1
D-	0.667
F	0

E. Grade Point Average (GPA)

To determine a student's GPA, the total number of grade points earned is divided by the number of graded credit hours at the 400 level or higher that are attempted. The cumulative and semester GPAs will include the effect of any A+ grades awarded (at 4.33 grade points) up to a grade

point average of 4.000. The grade point average will be calculated to three decimal places.

F. Post-Baccalaureate Studies (PBS)

Up to 12 credits earned in PBS courses with at least a grade of “B” can be officially transferred into a student’s program; these courses are also included in the GPA.

G. Incompletes

The grade of Incomplete (“IN”) may be given in any course at the instructor’s discretion for work not completed because of a serious interruption in the student’s work not caused by their own negligence. An “IN” must not be used, however, as a substitute for an “F” or “U” when the student’s performance in the course is not passing. An “IN” is only appropriate when the student’s record in the course is such that the successful completion of particular assignments, projects, or tests missed as a result of a documented serious event would enable that student to receive at least a C. Only work missed may be completed; no additional assignments can be included.

A student who receives an “IN” must complete the unfinished work by the end of the next semester in which the student is enrolled, provided that this period is no longer than 12 months from the end of the semester or summer session in which the “IN” was received. Otherwise, the “IN” will be automatically converted to “F” or “U,” in accord with the grading option for a particular course. All grades of “IN” must be cleared prior to graduation. Students must not register again for any courses in which they have “IN” grades. Such registration does not remove “IN” grades, and the completion of the course on the second occasion will automatically result in an “F” for the incomplete course.

- Students whose only remaining requirement for graduation is removal of an “IN” are not required to register in the following semester to complete the work and graduate; however, only one registration-free semester is allowed.

In special cases, the Graduate School may grant an extension of a student’s incomplete grade. Either the online Grade Change system or an Extension of Incomplete Grade form must be submitted.

To discourage excessive and/or unwarranted use of incomplete grades and extensions for an individual student, an extension of an incomplete grade will not be granted by the Graduate School if the student holds incomplete grades in other courses at the time of the request.

H. External Transfer Credit

Except in the case of interinstitutional courses, grades transferred from another institution will not be included in the GPA. See Section 3.1 for more information about transferring graduate credits.

I. Repeating Courses

A graduate student may repeat a course in which a grade of “C-” or lower has been earned. Repeating a course where a grade of “C” or higher has been earned requires the specific recommendation of the advisory committee as well as the approval of the DGP and the Graduate School. Students who repeat a course, regardless of the grade previously earned, will have both grades counted in their GPA. The semester hours will be counted only once toward the required minimum hours.

J. Grade Changes (see Section 5 in NC State REG 02.50.03)

After grades are posted, they are not subject to change based on a change in an instructor’s judgment; nor are submitted grades to be revised on the basis of a second trial (e.g., a new examination or additional work undertaken or completed). Changes must be made within one calendar year after the date final grades were posted to correct an error of computation or transcription or where part of the student’s work has been overlooked.

To change a grade, the instructor submits a grade change accompanied by a justification. This change must be approved by the DGP and Department Head relevant to the course, the appropriate Associate Dean, and the Graduate School. “IN” or “LA” grade changes require only departmental approval.

3.18 Graduate Courses

A. Credentials Required for Teaching Graduate Courses

The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) requires that graduate courses be taught by faculty with an earned doctorate/terminal degree in the teaching discipline or a related discipline. To that end, the following requirements for the teaching of graduate courses are established:

1. Both primary and secondary instructors must be graduate faculty in the academic program offering the course or approved non-graduate faculty (see Section 1.3 of the Administrative Handbook, sub-sections C and E).
2. All instructors must have an active record in HR (Human Resources).
3. Sections of the following courses must be taught by associate or full members of the graduate faculty:
   - XXX 685 Master’s Supervised Teaching
   - XXX 686-687 Master’s Other Teaching
   - XXX 690 Master’s Exams
   - XXX 691-699 Master’s Research
   - XXX 885 Doctoral Supervised Teaching
   - XXX 886-887 Doctoral Other Teaching
   - XXX 890 Doctoral Exams
   - XXX 891-899 Doctoral Research
4. Support personnel do not need to be graduate faculty but they must have 0% teaching load assigned.
5. All sections must have valid instructors listed (STAFF or blank is not acceptable).

B. Graduate Courses

Course Number	Explanation
5XX	Letter Graded Master’s Courses
6XX	S-U Graded Master’s Courses
7XX	Letter Graded Doctoral Courses (ALL 7XX courses are restricted to the following classification of students: MR, DR, SR, SP and GR)

8XX	S-U Graded Doctoral Courses (ALL 8XX courses, with the exception of those specifically listed at the end of this section, are restricted to the following classification of students: MR, DR, SR, SP and GR)
9XX	Professional Courses in the College of Veterinary Medicine are not graduate courses and may not be counted in Plans of Work for graduate degrees.

C. 500-Level Letter Graded Master's Courses

Course Number	Explanation
500-589	Undesignated
590-599	Letter Graded Special Topic Master's Courses

Note: Courses at the 500 level are letter graded. Students cannot enroll in these courses for 'credit only.'

D. 600-Level S/U Graded Master's Courses

Course Number	Explanation
600-609	**Introductory, Seminars, Colloquiums**
600	Introduction to Graduate Study (in department or program)
601	Seminar (in department or program)
602-606	Seminar in <specialization> (in department or program)
607	Advanced Seminar
609	Colloquium
610-617	**Topics Courses**
610	Special Topics (in department or program)
611-613	Special Topics in <specialization> (in department or program)
615	Advanced Special Topics (in department or program)
616-617	Advanced Special Topics in <specialization> (in department or program)
620-626	**Problems Courses**
620	Special Problems (in department or program)
621-622	Special Problems in <specialization> (in department or program)
623-624	Miscellaneous Special Problems
625-626	Advanced Special Problems
630-634	**Independent/Individual Study**
630	Independent Study (in department or program)
631-634	Other independent or individual study courses
635-639	**Readings**
635	Readings (in department or program)
636-639	Advanced Readings
640-649	**Practicums**
640	Prepracticum
641-649	Practicum in <specialization> (in department or program)
650-659	**Internships**
650	Internship (in department or program)
651-659	Internship in <specialization> (in department or program)
660-669	**Miscellaneous**
660-669	Miscellaneous that do not fit into any other category
670-671	**Lab Rotations**
670-671	Lab Rotations
675-679	**Projects**
675-679	Project courses (of all types)
680-684	**Directed Study**
680-682	Directed Study (in department)
683-684	Advanced Directed Study
685-687	**Teaching**
685	Master's Supervised Teaching
686-687	Other Teaching
690	**Exams**
690	Master's Exams
691-699	**Research**
693	Master's Supervised Research
695	Master's Thesis Research
696	Summer Thesis Research
697	Final Research Project
699	Master's Thesis Preparation

Note: Courses at the 600 level are S/U graded. Students cannot enroll in these courses for a letter grade. Registration in 600-level courses is restricted to graduate or PBS status.

E. 700-Level Letter Graded Doctoral Courses

Course Number	Explanation
700-789	Undesignated
790-799	Letter Graded Special Topic Doctoral Courses

Note: Courses at the 700 level are letter graded. Students cannot enroll in these courses for 'credit only.' Registration in 700-level courses is restricted to graduate or PBS status.

F. 800-Level S/U Graded Doctoral Courses

Course Number	Explanation
800-809	**Introductory, Seminars, Colloquiums**
800	Introduction to Graduate Study (in department or program)
801	Seminar (in department or program)
802-806	Seminar in <specialization> (in department or program)
807	Advanced Seminar
809	Colloquium
810-817	**Topics Courses**
810	Special Topics (in department or program)
811-813	Special Topics in <specialization> (in department or program)
815	Advanced Special Topics (in department or program)
816-817	Advanced Special Topics in <specialization> (in department or program)
820-826	**Problems Courses**
820	Special Problems (in department or program)
821-822	Special Problems in <specialization> (in department or program)
823-824	Miscellaneous Special Problems
825-826	Advanced Special Problems
830-834	**Independent/Individual Study**
830	Independent Study (in department or program)
831-834	Other independent or individual study courses
835-839	**Readings**
835	Readings (in department or program)
836-839	Advanced Readings
840-849	**Practicums**
840	Prepracticum
841-849	Practicum in <specialization> (in department or program)
850-859	**Internships**
850	Internship (in department or program)
851-859	Internship in <specialization> (in department or program)
860-869	**Miscellaneous**
860-869	Miscellaneous that do not fit into any other category
870-871	**Lab Rotations**
870-871	Lab Rotations
875-879	**Projects**
875-879	Project courses (of all types)
880-884	**Directed Study**
880-882	Directed Study (in department)
883-884	Advanced Directed Study
885-887	**Teaching**
885	Doctoral Supervised Teaching
886-887	Other Teaching
890	**Exams**
890	Doctoral Exams
891-899	**Research**
893	Doctoral Supervised Research
895	Doctoral Thesis Research
896	Summer Thesis Research
897	Final Research Project
899	Doctoral Thesis Preparation

Note: ALL 800-level S/U graded doctoral courses with the exception of those specifically listed below are restricted to graduate or PBS status.

G. Catalog Descriptions for Research, Teaching, and Examination Courses

- XXX 685 Master's Supervised Teaching. Restricted to master's student. 1-3. Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion.
- XXX 688 Non-Thesis Master's Continuous Registration – Half-Time Registration. Restricted to master's students. 1. For students in non-thesis master's programs who have completed all credit-hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc. As noted in the prerequisite above, the course-inventory system restricts enrollment in this course to master's students only (class MR).
- XXX 689 Non-Thesis Master's Continuous Registration – Full-Time Registration. Restricted to master's students. 3 credit hours. For students in non-thesis master's programs who have completed all credit-hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. As noted in the prerequisite above, the course-inventory system restricts enrollment in this course to master's students only (class MR). Students may register for this course a maximum of one semester. Registration restricted to 3 credits only.
- XXX 690 Master's Examination. Restricted to master's students. 1-6 credit hours. For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. As noted in the prerequisite above, the course-inventory system restricts enrollment in courses with this number to master's students only (class MR). XXX 690 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.
- XXX 693 Master's Supervised Research. Restricted to master's students. 1-9 credit hours. Instruction in research and research under the mentorship of a member of the Graduate Faculty. In spite of the noted prerequisite the course inventory system actually restricts enrollment in courses with this number to student class MR or DR.

- XXX 695 Master's Thesis Research. Restricted to master's students. 1-9 credit hours. Thesis research.
- XXX 696 Summer Thesis Research. Restricted to master's students. 1 credit hour. Thesis research. Ten-week course beginning the first day of Summer Session I. XXX 696 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.
- XXX 699 Master's Thesis Preparation. Restricted to master's student. 1-3 credit hours. For students who are writing their theses. May be counted in the Plan of Work.
- XXX 885 Doctoral Supervised Teaching. Restricted to doctoral students. 1-3 credit hours. Teaching experience under the mentorship of faculty who assist the student in planning for a teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion. 885 Doctoral Supervised Teaching courses are restricted to Doctoral students only (class DR) by the course-inventory system as indicated by the prerequisite noted above.
- XXX 890 Doctoral Preliminary Examination. Restricted to doctoral students. 1-9 credit hours. For students who are preparing for and taking written and/or oral preliminary exams. 890 Doctoral Preliminary Examination courses are restricted by the course-inventory system to Doctoral students only (class DR) as indicated by the prerequisite noted above. XXX 890 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.
- XXX 893 Doctoral Supervised Research. Restricted to doctoral students. 1-9 credit hours. Instruction in research and research under the mentorship of a member of the Graduate Faculty. 893 Doctoral Supervised Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.
- XXX 895 Doctoral Dissertation Research. Restricted to doctoral students. 1-9 credit hours. Dissertation research. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above.
- XXX 896 Summer Dissertation Research. Restricted to doctoral students. 1 credit hour. Dissertation research. Ten-week course beginning the first day of Summer Session I. 895 Doctoral Dissertation Research courses are restricted to Doctoral students only (class DR) as indicated by the prerequisite noted above. XXX 896 cannot be used to fulfill course requirements, cannot be listed on the Plan of Work for credit, and cannot be transferred to another program.
- XXX 899 Doctoral Dissertation Preparation. Restricted to doctoral students. 1-3 credit hours. For students who are writing their dissertation. May count toward the Graduate Plan of Work.

Master's students going on to pursue a Ph.D. can register for Ph.D. coursework during their last semester of the master's degree instead of 689, 695, or 699 provided they have completed the master's degree requirements.

The courses are all variable credit, but none are zero credit courses.

1. The number of credits students register for in the courses should not exceed the upper limits stated in the descriptions.
2. As a general rule, master's students should not register for 8XX-level courses and doctoral students should not register for 6XX-level courses. The course inventory allows scheduling of students in the classes FR, JR, SO, SR. in courses numbered 800 where the course prefix is II.

H. Credit Hours for Intensive Graduate Courses

A maximum of one credit hour will be awarded per week of full-time study for graduate courses offered by NC State University. At least 60 days before such a course is taught, the syllabus must be submitted to the Graduate School for approval.

I. Syllabus Requirement for Graduate Courses

All instructors of graduate courses are required, no later than the first class, to provide students with a written or electronic course syllabus which contains the information listed in NC State's Syllabus Regulation (https://policies.ncsu.edu/regulation/reg-02-20-07/) (REG 02.20.07).

A syllabus must be approved by the Administrative Board of the Graduate School as part of a new course proposal.

3.19 Academic Difficulty

Graduate students may be terminated from the program at any time if, in the judgment of the degree-granting Department/Program and the Graduate School, a student fails to make satisfactory progress towards the completion of the degree (regardless of grades) or violates the NC State Code of Student Conduct. The definition of satisfactory progress toward completion of the degree program may differ among degree-offering units. Examples of unsatisfactory progress may include, but are not limited to, inadequate GPA, inadequate research and/or research skill or progress, failure to obtain satisfactory grades in required courses for the program, or failing the preliminary or final oral examination.

An overall GPA of at least 3.000 is required for graduation.

A. Academic Warning

Graduate students are given a notice of academic warning if they have accumulated 18 or fewer hours at the 400 level or above and have less than a 3.000 GPA. Students on academic warning may continue to hold an assistantship or fellowship provided the DGP supplies a justification as well as continuing to receive financial aid.

B. Academic Probation

Graduate students will be placed on academic probation if they have accumulated more than 18 hours at the 400 level or above and have a GPA in the range of 2.667 to 2.999. Students placed on academic probation will be ineligible for financial aid and appointment or reappointment to an assistantship or fellowship.

C. Termination

Graduate students will be terminated from their program of study if they have accumulated more than 18 hours at the 400 level or above and have a GPA below 2.667, or if they have accumulated 30 or more hours and have less than a 3.000 GPA. When terminated, a student may no longer register in a graduate classification (see Section 3.16 – Withdrawal from the University (p. 949) for more information on program termination.)

If a student's graduate degree program is terminated, s/he cannot use courses taken in PBS status after termination for credit toward the same graduate degree program.

D. Reinstatement

Under extenuating circumstances, the Director of Graduate Programs (DGP) may recommend and provide justification to the Graduate School to reinstate a student's graduate classification using the Reinstatement Form (https://www3.acs.ncsu.edu/gsoars4/reinstatement/search.php). This recommendation must be in writing and must be signed and approved by the advisory committee and the DGP or the Department Head before it will be considered. It must include a reasonable academic and mentoring plan for achieving at least a 3.000 average.

If approved, the Graduate School will execute a "Matriculation" action in SIS, accompanied by a confirmation letter to the DGP and a request to Registration and Records to update the student's academic standing. To register, the "advising service indicator" must be removed by either the Graduate School or the program as early as the following day. Students who request reinstatement of their assistantships/fellowships should ask their DGP to submit a request to the Graduate School along with the academic reinstatement request (https://www3.acs.ncsu.edu/gsoars4/reinstatement/search.php). The expectation is that the student's GPA will be at least a 3.000 at the end of the semester. Please refer to Section 4.2 (p. 959).

3.20 Graduation

A. Official Graduations

There are three official graduations per year at NC State: at the end of the Fall and Spring semesters and at the end of the second Summer session. Formal commencement exercises are held at the end of the Fall and Spring semesters; any student who completed their degree during a summer session is eligible to participate in the Fall commencement exercises. All students scheduled to graduate in the Fall or Spring semesters are strongly encouraged to attend the respective commencement. Any doctoral candidate wishing to have the degree conferred in absentia must notify the Graduate School in writing; master's candidates should contact their departments or programs. The diploma will include the program or, in the case of dual PhDs, both programs will be noted; concentrations will not be included.

Students may not participate in a University commencement ceremony until all degree requirements are met.

B. Date of Degree Conferral

The date of completion of the course of study is Commencement Day for a given semester or the last day of classes in the second summer session.

To graduate by that date, students in Ph.D./Ed.D. programs and in thesis master's programs must submit their dissertations/theses by the Graduate School's ETD deadlines (https://grad.ncsu.edu/students/etd/etd-deadlines/).

C. Graduation Clearance Period

Students who are on the graduation list but have outstanding requirements (incomplete grades, corrections in theses or dissertations, etc.) are put on "hold" by the Graduate School for a period of 30 days following graduation. The Director of Graduate Programs (DGPs) and Graduate Service Coordinators (GSCs) will be notified of this action. If these outstanding requirements are not completed within 30 days following the conferral date, the graduation application will be denied. The student must reapply for graduation in a future term once those requirements are completed.

D. Student Requests for Graduate School Certification of Completion of Certain Requirements

Graduate students who have completed all program requirements and are awaiting graduation can request the Graduate School to write a letter for a prospective employer or graduate program certifying that these requirements have been met. The Graduate School will respond to a request to certify completion of requirements within five working days of the receipt of the request in the Graduate School.

E. Posthumous Degrees

Programs can petition the Administrative Board of the Graduate School to award posthumous degrees. In most cases, these petitions have been approved for students who had completed a portion of their thesis or dissertation or at least the research upon which the final project would have been based. DGPs should contact the Graduate Dean for guidance in the preparation of the request for the Board's consideration.

3.21 Diplomas

To receive a diploma, a student must use the 'Apply for Graduation' link in MyPack Portal for the term in which they plan to graduate by the deadline noted in the Graduate School Calendar (Student Self Service > Degree Progress/Graduation > Apply for Graduation).

Doctoral students graduating in the Spring and Fall are awarded their diplomas during the commencement exercises. Both master's and doctoral students graduating at the end of second summer session, or those students receiving permission to receive the degree in absentia will be mailed their diploma from Registration and Records.

Students earning a Master of Arts, Master of Science, Doctor of Education or Doctor of Philosophy degree will receive diplomas designating the degree and the major or program of study; subplans or concentrations will be denoted on the transcript, but not on the diploma. Students earning a master degree in a designated field will receive diplomas indicating the field of specialization, e.g., Master of Forestry.

3.22 University Patent Agreement and Copyright Procedures

All students must sign the Patent Agreement via Student Self-Service in MyPack Portal by the completion of 12 hours or before they start their research, whichever is earlier.

For more details, refer to the Patent and Copyright Procedures (https://policies.ncsu.edu/policy/pol-10-00-01/) of NC State and the NC State policy on copyright regulation (https://policies.ncsu.edu/regulation/reg-01-25-03/).

3.23 Release of Student Information

Written Permission of Student Required to Release Records

In compliance with the Family Educational Rights and Privacy Act of 1974 (Buckley Amendment), the Graduate School will require written permission of the student before releasing any information in the student's educational record to any party outside of the University. The student must complete an Authorization to Release Information (https://grad.ncsu.edu/faculty-and-staff/forms/graduate-school-forms/) and submit it to the Graduate School Records Unit.

Student Requests for Graduate School Certification of Completion of Certain Requirements

Graduate students who have completed all program requirements and are awaiting graduation can request the Graduate School to write a letter to a prospective employer or graduate program certifying that these requirements have been met. The Graduate School will provide these certifications, but requires that the student submit the Authorization to Release Information form. The Graduate School will respond to a request to certify completion of requirements within five working days of the receipt of the request in the Graduate School.

3.24 Schedule of Required Documents

Required Forms/Actions [1]

Complete, official transcripts from universities and colleges attended, including degrees and dates awarded

When Required: Before the beginning of the first semester of enrollment

Who Initiates: Student is responsible for providing official transcripts to the Graduate School.

Patent Agreement

When Required: Before the end of the first semester of enrollment

Who Initiates: Initiated by student online via Student Self-Services in *MyPack Portal*.

Appointment of Advisory Committee and submission of Plan of Work

When Required: During second semester or earlier

Who Initiates: Initiated by student with Advisor and Committee. Approved and submitted to the Graduate School by the DGP (doctoral students only)

Assignment of Graduate School Representative, if required (doctoral students only)

When Required: After Plan of Graduate Work has been approved by Graduate School

Who Initiates: Appointed by the Graduate School

Request to Schedule the Preliminary Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (doctoral students only)

When Required: After written preliminary exams have been passed, but no later than one semester prior to final oral exam. Request must be received in Graduate School at least 2 weeks prior to proposed exam date.

Who Initiates: Initiated by student and submitted to the Graduate School by the DGP

Report on Outcome of Preliminary Oral Examination (doctoral students only)

When Required: Immediately after oral examination is completed

Who Initiates: Submitted to the Graduate School by the DGP within 5 working days of exam

Application to Graduate (replaces old Diploma Order Request card)

When Required: Thesis Students – when Final Oral Exam is Scheduled but no later than the Apply to Graduate Deadline

Who Initiates: Initiated by student online via *MyPack Portal*, by navigating to *Student Self Services, Degree Progress/Graduation, Apply for Graduation*

Request to Schedule the Final Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (doctoral students only)

When Required: Must be received in Graduate School at least 2 weeks prior to proposed exam date (see right), and no earlier than 4 calendar months after successful completion of preliminary exam

Who Initiates: Initiated by student and submitted to the Graduate School by the DGP.

Student must also apply to graduate at the same time via *MyPack Portal*.

Request for a Permit to Schedule the Master's Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (master's students only)

When Required: Must be received in the Graduate School at least 10 working days before the examination is scheduled

Who Initiates: Initiated by student and submitted to the Graduate School by DGP.

Student must also apply to graduate at the same time via *MyPack Portal*.

Report on Outcome of Final Oral Examination (http://www.ncsu.edu/grad/faculty-and-staff/forms-list.html) (master's or doctoral)

When Required: Immediately after final oral exam

Who Initiates: Submitted to the Graduate School by the DGP

Draft submission of thesis or dissertation to Graduate School for thesis review

When Required: Immediately after final examination is successfully completed (***within 24 hours of receiving an unconditional pass***). This must be completed by the graduation deadline for the semester as noted in the Graduate School Calendar (http://www.ncsu.edu/grad/faculty-and-staff/calendars.html).

Who Initiates: Student must electronically submit the draft PDF file to the Thesis Editor via the ETD submission system for the thesis review.

Final submission of thesis or dissertation to Graduate School for Graduate School acceptance

When Required: Final error free file must be submitted before the deadline for the semester as noted in the Graduate School Calendar (http://www.ncsu.edu/grad/faculty-and-staff/calendars.html).

Who Initiates: Student must electronically submit the final error free file to the Thesis Editor via the ETD submission system for acceptance by the Graduate School.

Final committee approval of thesis or dissertation

When Required: Online approval by the student's advisory committee, through *MyPack Portal* before the deadline for the semester as noted on the ETD web page.

Who Initiates: Student unconditionally passes the final exam and the ETD is accepted by the Thesis Editor.

[1] Receipt of materials in the Graduate School can be by campus mail, hand delivery, fax, or e-mail, as appropriate.

4.1 Assistantships, Fellowships, Traineeships, and Grants

Students admitted to the Graduate School may be awarded financial support in the form of an assistantship or fellowship (sometimes referred to as a traineeship). These programs provide financial support to enable students to focus their work on their degrees. Student's assignments should be in direct or general support of the teaching, research or extension missions of the university for the mutual benefit of the graduate students and his/her graduate program.

A. Eligibility

In order to be eligible for graduate teaching, research, or extension assistantships and fellowships (traineeships), students must be admitted into the Graduate School in full graduate standing and be enrolled in the fall and spring semesters. Students must also be in good academic standing (with a 3.000 grade point average or higher), unless granted an exception by the Graduate School. Some fellowships (traineeships) have additional eligibility requirements, e.g., a GPA higher than 3.000 or a specific research focus. It is the responsibility of the student to consult the Director of Graduate Programs (DGP) for information on specific eligibility requirements. . Graduate Certificate Students are eligible for appointment as Graduate Service Assistants but not research, teaching or extension assistantships.

The position of the Graduate School is that any graduate student holding a graduate research, teaching, or extension assistantship requiring 20 hours of work per week or more (i.e. half-time or greater) must, as a condition of such assistantship, maintain his/her status as a full-time student, and therefore, should not be otherwise employed. The reason for this position is to encourage students to work on their degrees rather than part-time jobs and to ensure that additional employment is approved by the student's department. If a department wishes to increase a graduate assistant's financial support, the stipend should be increased. If additional time is required, the student's FTE should be adjusted accordingly. International graduate students on F-1 and J-1 visas are limited to 20 hours of service work per week.

B. Definitions

The following definitions have been recommended by the Administrative Board of the Graduate School and approved by the Graduate School. Graduate departments and programs have the responsibility of determining whether or not the assignments given to their graduate student assistants are in direct or general support of the teaching, research or extension missions of the university.

1. Graduate Teaching Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the teaching mission of the unit as instructor of record, lab instructor, recitation leader, lab or lecture assistant, or who has responsibilities in direct support of classroom instruction in the unit, such as setting up labs or working in an instructional computer lab; or
   b. provides general support to the teaching mission of the department or program.
2. Graduate Research Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the research mission of the unit, or an on-campus or off-campus organization that is affiliated with the unit, in the design of experiments, data collection, analysis, or reporting of research results in the student's field of study, where research may, but is not required to, contribute directly to the student's thesis or dissertation; or
   b. provides general support to the research mission of the unit or discipline.
3. Graduate Extension Assistant – A student who is appointed in an academic department or program and
   a. directly participates in the extension, outreach and engagement mission of the unit, or an on-campus or off-campus organization that is affiliated with the unit, in the design of projects, data collection, analysis, application, or reporting of results in the

student's field of study, where these activities may, but are not required to, contribute directly to the student's thesis or dissertation; or

b. supports the extension, outreach and engagement mission of the unit or discipline, including substantive interaction with individuals or groups beyond the university.

4. Graduate Services Assistant – A student who is appointed to a position that serves the university outside of an academic department or program's teaching or research mission during the academic year.
5. Graduate Fellow (Trainee) -A student who is provided a stipend that has no corresponding service obligation. Stipends from graduate fellowships (traineeships) are based on academic scholarship and/or financial need criteria. Students may contact the DGP for information on fellowships (traineeships) that may also provide tuition, fees and/or educational expense allowances.

C. Responsibilities

1. Graduate Teaching Assistants – A 1/2-time Graduate Teaching Assistant is required to spend approximately 20 hours per week fulfilling assigned teaching responsibilities associated with the stipend. These duties may be independent of teaching activities that contribute to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.
   a. Orientation to Teaching for New Graduate Teaching Assistants. All new Graduate Teaching Assistants and other graduate students with newly assigned teaching responsibilities are required to attend a University-wide Teaching Orientation, which has traditionally been held each August, shortly before classes start. The Orientation is sponsored by the Graduate School.
   b. International Teaching Assistant (ITA) Screening. All International Teaching Assistants (ITAs) whose responsibilities include significant interaction with undergraduates in a classroom or laboratory must be screened for oral English proficiency before they are permitted to assume these responsibilities. If the screening process indicates that an ITA needs to improve his or her spoken English significantly in order to communicate effectively with his or her students, he or she must take FLE 400 (American English Pronunciation for International Students) or FLE 401 (Oral Communication and Teaching Skills for International Teaching Assistants) before being re-screened.Screening Process. Screening sessions for new and continuing ITAs are held each August, November, January, and April. DGPs and Graduate Services Coordinators will receive a request that they sign up students online for the SPEAK test six to eight weeks prior to each screening. It is the responsibility of the DGPs or Graduate Services Coordinators to notify the students of their test date, time, and location.

      The Spoken English Assessment Test (SPEAK), an institutional version of the Educational Testing Service's Test of Spoken English, screens ITAs for proficiency in oral English. Administered in the Foreign Language Laboratory and rated by specialists in English as a Second Language, the SPEAK test consists of a series of prompts for which each student's responses are recorded. No special preparation is necessary. After each student's test is graded, scores are posted on a secure website for departmental access. The score will determine what responsibilities each ITA may assume.

      Depending on their scores, ITAs may be cleared for either lead teaching responsibility in a classroom or lab or for limited teaching responsibility in settings where a faculty member or experienced TA has primary teaching responsibility. If an ITA is cleared only for limited teaching responsibility, before being assigned full responsibility for a class, lab, discussion section, etc., he or she must take FLE 400 or FLE 401, be re-screened, and achieve the score appropriate for full teaching responsibility. ITAs whose scores indicate that their spoken English must improve before they can assume even limited teaching responsibilities should not be assigned any duties that require significant verbal interaction with undergraduates. If their departments wish them to assume either limited or full teaching responsibilities, these students must first take FLE 400 and/or 401 and then be re-screened and achieve the appropriate score for either limited or full responsibility.
2. Graduate Research Assistants – A 1/2-time Graduate Research Assistant is required to spend approximately 20 hours per week fulfilling the assigned research responsibilities associated with the stipend. These duties may be independent of research activities that contribute to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.
3. Graduate Extension Assistants – A 1/2-time Graduate Extension Assistant is required to spend approximately 20 hours per week fulfilling his/her assigned extension, outreach and engagement responsibilities associated with the stipend. This may be independent of time spent in research or teaching or extension, outreach and engagement activities that are part of the academic requirements of the degree program. Time commitment for students whose appointment is less than or greater than 1/2-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e. 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.
4. Graduate Services Assistants – A 1/2-time Graduate Services Assistant is required to spend approximately 20 hours per week fulfilling assigned responsibilities associated with the stipend. Commonly, the duties are independent of time spent in research or teaching activities contributing to the requirements of the degree program. Time commitment for students whose appointment is less than or greater than half-time are in the same proportion to a 40-hour week as that of the 1/2-time appointment, i.e., 10 hours for a 1/4-time appointment and 30 hours for a 3/4-time appointment.
5. Graduate Fellows (Trainees) – Graduate fellows (trainees) have no service obligation. However, they must fulfill all research and teaching requirements of their degree programs and, in many cases, additional requirements stipulated by their fellowship (traineeship) programs.

D. Benefits of Assistantships and Fellowships

1. Graduate Teaching Assistants, Graduate Research Assistants, Graduate Extension Assistants, and Graduate Fellows (Trainees) are provided health insurance through the Graduate Student Health

Insurance (GSHI) Plan under the conditions specified in the Graduate Student Support Plan.

2. Graduate Teaching Assistants, Graduate Research Assistants, Graduate Extension Assistants, and Graduate Fellows (Trainees) are provided in-state tuition and tuition remission as specified in the Graduate Student Support Plan (https://grad.ncsu.edu/students/gssp/).
3. The Graduate Student Support Plan excludes the participation of Graduate Services Assistants in health insurance, instate tuition and tuition remission benefits.
4. Student assistants, i.e., biweekly appointees, will under no conditions be eligible for the health insurance plan or the tuition benefits of the Graduate Student Support Plan.
5. Many fellowships and traineeships include “cost-of-education” (COE) or “educational enhancement” funds in addition to funds for stipends, tuition, and health insurance. The Graduate School processes all expenditures of these funds. By the first of September, the Graduate School Fellowship Office sends each department/program a list of all its current Fellows (Trainees) who have access to COE funds. These funds may be used for research- and course-related books, supplies, equipment, and travel. Fellows are informed of this support in their award letters and are provided instructions as to making expenditures.

4.2 RA and TA Appointments

A. Appointing Students to Graduate Assistantships

All Graduate Teaching Assistants (GTAs), Graduate Research Assistants (GRAs), and Graduate Services Assistants (GSAs) are appointed in the University’s HR System and are paid on the University’s biweekly payroll cycle. Students must sign up for direct deposit through Employee Self-Service in MyPack Portal.

Graduate students who are paid on a temporary/hourly basis may not be given the title Graduate Research Assistant, Graduate Teaching Assistant, Graduate Extension Assistant, or Graduate Services Assistant. Temporary appointees may be referred to as student workers.

- Graduate Teaching Assistants: Appointed in the University HR system under Job Code A138, A178, A438, A478/Employee Class GRD, Department ID from 11#### -20####.
- Graduate Research Assistants: Appointed in the University HR System under Job Code A148, A178, A448, A478/Employee Class GRD, Department ID from 11#### -20####.
- Graduate Extension Assistants: Appointed in the University HR System under Job Code A428, A438, A448, A478/Employee Class GRD, Department ID from 11#### -20####.
- Graduate Services Assistants: Appointed in the University HR System under Job Code A198/Employee Class GRD.

B. Procedures for Paying Fellowship Stipends/Awards

NC State University, effective July 1, 1997 (updated June 1, 2012)

All graduate fellowship stipends/awards are entered in the University’s Financial Aid System by the Graduate School based on information provided by departments on the Graduate Fellowship Payment Information Form. A copy of the graduate fellowship stipend/award letter attached to the Graduate Fellowship Payment Information Form must be forwarded to the Graduate School for all new fellowship stipends/awards by the 15th of the month in which disbursements begin.

Students receive monthly payments through the Cashier’s Office, and students must sign up for direct deposit through Student Financials in MyPack Portal.

1. Determining the Primary or Supplemental Status of a Fellowship

   A primary fellowship is one that pays a stipend/award of $3,000 or more for the Fall or Spring academic term. Health insurance benefits, in-state tuition awards, and tuition remission (if applicable) must be provided under the terms and conditions of the Graduate Student Support Plan, if the student meets the Plan’s registration requirements. A primary fellowship is responsible for the total cost of the health insurance benefits, in-state tuition, and tuition remission matching (if applicable). Tuition remission match is 25% of the out-of-state tuition amount and is only applicable to out-of-state students. Health insurance coverage remains in force only as long as the fellowship appointment remains in effect. If any part of the benefits package (where applicable) cannot be paid by the fellowship funds, the college must cover it from other sources of funds.

   A supplemental fellowship is one that pays a stipend/award less than $3,000 for the Fall or Spring academic term. Supplemental fellowships are not used to determine eligibility for health insurance, in-state tuition awards, or tuition remission. Recipients of supplemental fellowships will not be eligible for health insurance and tuition remission unless they have other qualifying assistantship appointments or primary fellowships.
2. Fellowship Assignment Guidelines

   The following guidelines apply to fellowships in order to distinguish them from assistantships and retain their “exempt from withholding” status:

   All fellowship assignments will be entered in the SIS Financial Aid System with an stipend/award amount and the dates for disbursement. The designation of the fellowship as primary or supplemental will be determined by both the award amount and the dates for disbursement.

   Examples are:
   a. If a student will be paid a graduate fellowship of $14,000 in equal monthly installments over an academic year (fall and spring terms), the stipend/award amount entered into the Financial Aid System will be $14,000. The effective date will be 8/1/XX and the end date will be 5/31/XX, with disbursements paid August through May. This is a primary fellowship.
   b. If a student will be paid a graduate fellowship of $5,000 in equal monthly installments over an academic year (Fall and Spring Terms), the stipend/award amount entered into the Financial Aid System will be $5,000. The effective date will be 8/1/XX and the end date will be 5/31/XX, with disbursements paid August through May. This is a supplemental fellowship.

Note: Fellowship payments default to equal monthly amounts over the disbursement period. The default disbursement schedule/monthly amount can be overridden when needed. The reason for the adjustment should be provided on the Graduate Fellowship Payment Information Form.

c. If a student will be paid $2,500 in August, and $2,500 in January, a stipend/award of $5,000 will be entered in Financial Aid. The first $2,500 installment will be designated for the Fall term with disbursement in August, and the second $2,500 installment will be designated for Spring term with disbursement in January. Since the payments are not continuous, this is a supplemental fellowship; please keep in mind that in order to qualify for continuous health insurance benefits throughout the academic year, the student must be receiving continuous biweekly "primary" fellowship payments.

The process to determine a graduate student's eligibility for health insurance benefits, in-state tuition, and tuition remission will read this stipend/award in Financial Aid in the same way it reads a graduate assistantship appointment in the HR System. In the case of a primary fellowship, eligibility and payment responsibility for graduate student support will be determined on the value of the primary fellowship stipend/award alone.

If the country of legal residence is not the US, taxes will be withheld, or not, based on the country of residence.

In addition to the stipend/award amount, many fellowships include the cost of education and/or educational enhancement funds. These funds may be used to pay the fellow's tuition, fees, books, supplies, travel, and other costs that directly support the student's educational program. These funds will be managed by the fellow's department or college and in some cases, the Graduate School. Expenditure of these funds will continue to be processed through Accounts Payable as it has in the past.

A No-Pay Graduate Fellowship job record will be entered in the HR System by the Graduate School based on information provided in the Graduate Fellowship Payment Information Form; this No-Pay job record will provide the student with access to the University's Marketplace and Travel Systems. Cost of education and educational enhancement funds will not be used to determine eligibility for the health insurance benefits, in-state tuition awards, or tuition remission.

C. Terms and Conditions of Assistantship Appointments

When appointing students to Graduate Research/Teaching/Extension Assistantships, the terms and conditions for the appointment must be presented in writing to the student. The Terms and Conditions for Appointment document may be used as a stand-alone document. If the department chooses to send its own letter of appointment, the Conditions for Appointment statement must be attached. Also, a checklist, Items to be Included in Letters of Offer Along With Generic Form of Conditions for Appointment, is provided to ensure that departments include all necessary information in their assistantship offer letters.

The "Terms and Conditions" document must be used to make clear the expectations the University has for Teaching, Research and Extension Assistantships and for the individual on these appointments to know the conditions upon which they are appointed and the benefits they are entitled to in exchange for their performance.

Procedures

1. Initial Graduate Assistantship Appointment

   Each student who is offered a Graduate Research/Teaching/Extension Assistantship will be notified in writing of the terms and conditions of their appointment. The following documentation is required for all new or initial Graduate Research/Teaching/Extension Assistantship appointments:

   a. Completed and signed Terms and Conditions for Appointment document OR the Conditions for Appointment document, along with a letter of offer stating the "terms" of appointment
   b. I-9 and e-Verify completed through Guardian.The department submits completed and signed documents attached to the HR System Personnel Action Form (PAF) to the Graduate School. No assistantship is in effect until (a) all documentation is submitted and approved by the Graduate School, and (b) the appointment has been entered into the Human Resources (HR) System. The information in the HR System must match the terms and conditions document. The appointment end date from the terms and conditions document represents the last day the student will be paid, and the date is entered in the HR System as both the "appointment end date" and the "expected job end date." Graduate assistant appointments are systematically terminated in the HR System based on the "expected job end date."

2. Extension of Graduate Assistantship appointment or additional Graduate appointment

   A change to the appointment such as an extension of the current appointment that is not reflected in the initial "Terms and Conditions" document or the initial "Conditions for Appointment" document and letter of offer necessitates a new, signed Terms and Conditions document reflecting the change(s). Both the student and the Director of Graduate Programs (DGP) must be in agreement to change the terms and conditions of the existing appointment.

   For example, if the initial Terms and Conditions of the Graduate Assistantship indicated support for a three (3) year appointment, the initial document would cover continuous payments for that three-year period of time unless changes were made to the terms of the appointment. If the initial "Terms and Conditions" document reflected support for a one (1) year Graduate Assistantship, this initial document would cover continuous payments as a Graduate Assistant for the one-year term only.

   Any appointment not covered in the initial Terms and Conditions requires a new Terms and Conditions document. Appointments that are extended necessitate a new, signed Terms and Conditions. Payroll actions extending the appointment must be processed in the HR System at least three weeks prior to the planned exit date to insure that continuous pay is not disrupted. The department submits completed and signed documents attached to the HR System Personnel Action Form (PAF) to the Graduate School. No

reappointment is in effect until (a) all documentation is submitted and approved by the Graduate School, and (b) the appointment has been entered into the Human Resources (HR) System.

3. Termination of Graduate Assistantship prior to the end of the contract

   If a graduate assistant resigns prior to the end of the contract stated in his/her "Terms and Conditions" document, a letter of resignation or a memorandum documenting the resignation is required. A copy of the required back-up documentation in #8 of the "Terms and Conditions" document attached to the HR System Personnel Action Form (PAF) must be forwarded to the Graduate School once the termination action has been entered and approved in the HR System.

   If a department terminates a graduate assistant prior to the end of the contract stated in the "Terms and Conditions" document, a copy of the required back-up documentation in #8 of the "Terms and Conditions" document attached to the HR System Personnel Action Form (PAF) must be forwarded to the Graduate School once the termination action has been entered and approved in the HR System.

4. Reinstatement of Assistantship

   Students who have their assistantship terminated due to academic difficulty must have their DGP submit a separate request for reinstatement and academic exception to their Graduate School Liaison.

5. Human Resources (HR) System

   Data entry in the HR System must reflect the current appointment(s). This includes title, compensation rate, FTE, and dates of appointment, as reflected in the "Terms and Conditions" document.

6. Terms and Conditions for Self-Supporting Students

   Self-supporting students enrolling at NC State may be asked by their department to complete the Terms and Conditions for Self-Supporting Students document when they enter a graduate program. This document outlines their academic obligations, but in no way obligates the University to any financial responsibility for the student.

D. Assistantship Course Load

Students appointed to assistantships should consider the number of credit hours for which they register in any given fall or spring semester in light of the duties expected of them as a result of the assistantship. Limits to the number of credits such students may register for in a semester may be imposed by individual advisers or by programs. In such cases, registration should be established in consultation with the student's adviser and/or DGP.

E. Taxation of Assistantships and Fellowships

All scholarship and fellowship payments are reportable on the recipient's income tax returns. This includes the amount of any tuition remission a student may have received, which is treated as a fellowship for tax purposes.

All assistantship payments are considered wages and will be paid and reported by the University payroll system. They will be subject to tax withholding.

The University Payroll Office can answer questions concerning current tax issues. Also refer to the Internal Revenue Service and/or NC Department of Revenue.

F. Managing Fellowships and Grants

In addition to fellowships and traineeships administered by individual colleges and departments, the Graduate School administers a number of fellowships (traineeships) and grants. These include:

1. "Portable" fellowships awarded by foundations and government agencies, which individual students "bring" to the University and which the Graduate School is asked to administer;
2. Federally funded fellowships (traineeships) awarded to the University as a result of grant proposals, which are often used to recruit students to specific interdisciplinary programs of study and research;
3. Institutional fellowships funded with income from university fellowship endowments;
4. Grants to support graduate student diversity (see below).

Regarding University-awarded fellowships, in most cases students are nominated by their graduate programs or colleges rather than applying directly for the fellowships. Recipients are selected either by the Credentials and Awards Committee of the Administrative Board of the Graduate School or by a selections committee of faculty who help direct a specific training program.

1. Fellowship Information and Nominations Procedures

   Graduate School Fellowship Information on the Graduate School web site provides an overview of types of funding available for graduate education, descriptions of selected NC State fellowships administered by the Graduate School, and searchable databases for nationally competitive fellowships and other funding opportunities. Both campus-based and national fellowship competitions are routinely announced in the NC State Online Bulletin. For University-wide fellowships, calls for nominations are sent to DGPs and/or Associate Deans, depending on the selections process. For training grants, which are much narrower in scope, calls for nominations are e-mailed to the training faculty identified in the grant proposal or to DGPs whose programs are eligible to nominate trainees. To nominate students for diversity grants, DGPs should contact the Graduate School. Further information on all funding opportunities is available by contacting Dr. David Shafer, Assistant Dean of the Graduate School.

2. Generating Fellowship (Traineeship) Programs

   Researching opportunities and submitting proposals for new fellowship (traineeship) programs is a coordinated effort among the NC State Graduate School, faculty, and the Proposal Development Unit (PDU), which is part of the Office of Research, Innovation, and Economic Development. The PDU provides support for faculty producing large-scale proposals for graduate fellowships with a goal of enhancing competitiveness for research and graduate fellowship funding. In most cases, funded fellowship proposals are administered by the Graduate School.

3. Managing Fellowship (Traineeships) and Diversity Grants: The Role of the Graduate School

   For all fellowships (traineeships) and grants administered by the Graduate School, the Graduate School appoints the students through the Financial Aid System and sets up their accounts. If their award qualifies them for the Graduate Student Support Plan, the Graduate School also pays their tuition, health insurance, and any other fees covered by the fellowship or traineeship, as well as the monthly stipend.

   For fellowships and grants with a need-based stipend, the Graduate School also calculates the appropriate stipend/award level. If the fellowship brings with it an educational enhancement allowance for books, supplies, professional travel, etc., the Graduate School sets up an account for these funds and monitors their disbursement. Finally, the Graduate School monitors the academic progress of students receiving funding from fellowships, traineeships, and grants to ensure that they are meeting the academic requirements of their funding.

   For institutionally awarded fellowship and traineeship programs and for diversity grants, the Graduate School, in consultation with the training faculty, has some or all of the following additional responsibilities:
   a. Sending out calls for nominations and collecting nomination/application materials
   b. Coordinating the selections process for the faculty selections committee
   c. Sending out award letters
   d. Coordinating arrangements for orientation of new fellows and trainees
   e. Coordinating the annual evaluation of fellows (trainees) and the training programs themselves
   f. Coordinating competitions to fill any traineeship vacancies
   g. Monitoring trainees' participation in required professional development programs
   h. Coordinating related professional development activities such as seminars and mini-grant competitions for which the Graduate School is responsible
   i. Submitting reports to the funding agency.
4. Managing Graduate Fellowships (Traineeships) and Grants: The Role of Directors of Graduate Programs (DGPs) and Other Graduate Faculty

   Depending on the requirements of the fellowships (traineeships) or grants of students in their programs, DGPs and training faculty have one or more of the following responsibilities:
   a. Mentoring fellows (trainees) and grant recipients to ensure that they are effectively integrated into their graduate programs, that they understand and fulfill the conditions of their awards, and that they make satisfactory progress toward the degree.
   b. Notifying the Graduate School if the department or program does not receive the student's stipend check on time.
   c. Submitting annual evaluations of fellows (trainees) who are their advisees and seeing that these advisees submit annual activity reports to the Graduate School on time.
   d. Notifying the Graduate School of any student whose fellowship (traineeship) or grant should be terminated because:
      - the student is switching to a degree program or research focus ineligible for fellowship (traineeship) funding;
      - the student has accepted outside employment that makes him or her ineligible for his or her award; or
      - the student is withdrawing from the University.
   e. Working with department heads to ensure that the department or program honors any financial commitments associated with accepting students with a specific financial award, such as the following:
      - For those programs that require them, providing supplements to the stipend awarded through the grant;
      - For supplemental fellowships or grants that require them, ensuring that the student also has an assistantship stipend per semester;
      - Using tuition remission slots for out-of-state students in fellowship programs that require tuition remission as part of an institutional match;
      - Ensuring that fellows (trainees) participate in those professional development activities outlined in the traineeship proposal, such as Preparing the Professoriate, research ethics training, internships, or service learning;
      - If applicable, providing support for the student beyond the length of the fellowship (traineeship) until the degree is completed, provided that the student is making satisfactory progress toward the degree and usually for no more than a total of five years of combined support.
5. Diversity Grants for Students from Underrepresented Groups

   Diversity Enhancement Grants are funded by the State of North Carolina for students who are accepted in master's or Ph.D. programs at NC State. Criteria for selection include: academic record, character, creativity, educational and economic background, race and ethnicity, gender, exceptional personal talents, unique work or service experience, and leadership potential. Applicants must add to the goal of increasing diversity in graduate education at North Carolina State University. Recipients are awarded stipends based on financial need for the academic year, with an option of additional support for study in the summer session.

5.1 Discipline and Grievance Procedures

Graduate Student Discipline Procedures

Disciplinary procedures that apply when a graduate student is charged with academic misconduct in violation of the Code of Student Conduct and the misconduct involves the graduate student's thesis or dissertation are contained in REG 11.35.03 (Graduate Student Discipline Procedures).

Allegations of research misconduct involving a graduate student's thesis or dissertation are subject to REG 10.00.02 (Responding to Allegations of Research Misconduct).

REG 11.35.02 (Student Discipline Procedures) govern all other alleged violations of the Code of Student Conduct by graduate students.

Grievance Procedures for Graduate Students

Most problems encountered by graduate students can be resolved through communication between the student and the party whose action created the problem. If that is not the case, REG 11.40.02 (Grievance Procedure for Graduate Students outlines both informal and formal methods for resolving the problem.

Graduate Catalog Archives (2003-2020)

Incoming students are governed by the rules and regulations in force the semester they are accepted into a program. Previous Graduate Catalogs can be downloaded in PDF format here.

Graduate Catalog (2019-2020) (https://grad.ncsu.edu/wp-content/uploads/2019/07/Graduate-Catalog-2019-2020.pdf)
Graduate Catalog (2018-2019) (https://grad.ncsu.edu/wp-content/uploads/2018/07/Graduate-Catalog-2018-2019.pdf)
Graduate Catalog (2017-2018) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2017-2018.pdf)
Graduate Catalog (2016-2017) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2016-2017.pdf)
Graduate Catalog (2015-2016) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2015-2016.pdf)
Graduate Catalog (2014-2015) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2014-2015.pdf)
Graduate Catalog (2013-2014) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2013-2014.pdf)
Graduate Catalog (2012-2013) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2012-2013.pdf)
Graduate Catalog (2011-2012) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2011-2012.pdf)
Graduate Catalog (2010-2011) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2010-2011.pdf)
Graduate Catalog (2009-2010) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2009-2010.pdf)
Graduate Catalog (2008-2009) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2008-2009.pdf)
Graduate Catalog (2007-2008) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate-Catalog-2007-2008.pdf)
Graduate Catalog (Spring 2007) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Spring_2007.pdf)
Graduate Catalog (Fall 2006) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Fall_2006.pdf)
Graduate Catalog (Spring 2006) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Spring_2006.pdf)
Graduate Catalog (Fall 2005) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Fall_2005.pdf)
Graduate Catalog (Spring 2005) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Spring_2005.pdf)
Graduate Catalog (Fall 2004) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Fall_2004.pdf)
Graduate Catalog (Spring 2004) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Spring_2004.pdf)
Graduate Catalog (Fall 2003) (https://grad.ncsu.edu/wp-content/uploads/2017/08/Graduate_Catalog_Fall_2003.pdf)

Doctor of Veterinary Medicine

At the NC State College of Veterinary Medicine, world leading faculty lead extraordinary programs in learning and discovery. We instruct students in a range of scientific disciplines related to health and disease control in animals. In addition to teaching foundational classes in medical topics, students are trained in clinical skills needed to diagnose and treat illness in animals.

The clinical program at NC State Veterinary Medicine provides a heavy emphasis for actual “hands-on” clinical practice and is demanding both physically and mentally. Students select “focus areas” to increase their depth of training in their intended area of post-graduate activity, while still retaining a broad based veterinary education.

Faculty also encourage and challenge students to develop the personal and professional knowledge and skills needed to serve a global community. For detailed information regarding our program, choose an area of interest from the menu on the left hand side of this page.

The Evolution of an Expert

Our goal is to prepare graduates who step into the profession with the most up-to-date veterinary medical knowledge possible, skills that prepare them to practice veterinary medicine at the top of their fields, an awareness of the veterinary issues at a local, national, and international level, and a dedication to the continued pursuit of knowledge throughout their professional lives. As such, we have built into our curriculum the following measures of success in each of these important areas:

Knowledge

A graduate will effectively use knowledge of comparative medical science in the provision of veterinary clinical care and other contexts in which veterinary medicine plays a key role. This is characterized as the ability to:

- possess and apply the knowledge needed to solve animal health problems
- locate the needed knowledge efficiently and successfully, using contemporary media and technology to access and manage information
- critically evaluate information and its sources
- integrate medical and scientific information and apply it to the solution of animal health problems

Skills

A graduate will effectively use cognitive and psychomotor skills in the practice of veterinary clinical care and other contexts in which veterinary medicine plays a key role. This will be characterized as the ability to:

- identify, define and analyze clinical problems of a diverse range of species
- identify or create processes to solve clinical problems in a diverse range of species
- interpret facts and data in the context of the clinical problems to be solved
- design preventative and therapeutic plans for common medical problems of animals and animal-human disease interactions
- perform surgical and medical procedures needed to care for veterinary patients, demonstrating acceptable standards of animal handling, pain control, sterility, instrument and device handling, tissue handling and safety
- perform imaging and other diagnostic procedures and accurately interpret obtained data used for the diagnosis and treatment of disease in animals
- use scientific methods for the investigation of problems and use research-based information in the clinical care of veterinary patients

Awareness

A graduate will effectively use awareness of local, national, international and professional communities in which he or she practices to meet the needs of society in an effective and ethical manner. This will be characterized as the ability to:

- acknowledge personal responsibility for one’s value judgments and behavior
- understand and accept social, cultural, global and environmental responsibilities, particularly as they relate to animal welfare, sustainability of animal resources, and one health
- demonstrate professionalism in the face of societal diversity, including racial, ethnic, gender, sexual orientation, socio-economic and cultural differences
- work with, manage, and lead others in ways that facilitate their contribution to the organization and the wider community
- use communication as a tool for interacting and relating to others, demonstrating patience, compassion and empathy
- make effective use of oral, written, and visual means to critique, negotiate, create and communicate understanding
- apply sound business and management principles to the organizations in which one works
- operate within the legal constraints of the society in which one lives
- exhibit truth, honesty, integrity, open-mindedness, fairness and generosity

Life-long Learning

A graduate will continuously update his or her knowledge, skills and awareness. This will be characterized as the ability to:

- be independent learners who take responsibility for their own learning and practice continuous reflection, self-evaluation and self-improvement
- critically evaluate one’s current knowledge, skills and awareness, recognizing areas for improvement
- be open to new ideas, methods and ways of thinking be able to identify processes and strategies to learn and meet new challenges
- have a personal vision and goals and be able to work towards these in a sustainable way

Applicants are evaluated on their academic performance (https://cvm.ncsu.edu/education/dvm/admission/eligibility/), their understanding of the veterinary medical profession, their achievements, and their professional potential.

Pre-veterinary students can pursue any undergraduate major they choose, and the required pre-professional courses can be obtained

through the curricula of a number of fields of study. An undergraduate degree, however, is not required for admission. *"Pre-vet" is not a major*; it is a track that can be chosen within a major. Popular majors for pre-professional students include animal science, poultry science, zoology, biology, biochemistry, and microbiology. Applicants must only complete prerequisite courses to fulfill academic admission requirements (https://cvm.ncsu.edu/education/dvm/admission/faq/).

NC STATE ANNOUNCES THE FOLLOWING ADVISORY TO ADMISSIONS REQUIREMENTS FOR THE 2021 ADMISSIONS CYCLE:

1. **P/F grades:** NC State will allow a Pass in P/F or Satisfactory in the S/U grading systems for prerequisites completed in Spring or Summer 2020
   - courses submitted in the P/F or S/U scale will not be factored into the Required Course GPA calculation
2. **GRE:** NC State has waived the GRE General Test for the 2021 admissions cycle
   - If you have already taken the test, please do not send scores to NC State directly or to NC State via VMCAS. A decision about requiring the GRE for the 2022 admissions cycle will be made in Fall 2020.
3. **LORs:** NC State will continue to require three (3) letters of recommendations. Additionally, we still highly recommend that 2 of 3 letters come from DVMs or PhD scientists with whom you have worked.
4. **Experience Hours:** NC State will continue to require 200 hours of veterinary experience hours for the 2021 admissions cycle.

Letter grades with at least a C- or better will be required in all semesters following Spring and Summer 2020 as long as COVID-19 restrictions have been lifted. **A "Pass" or "Satisfactory" grade for a prerequisite taken in Spring or Summer 2020 will be accepted in any future admissions cycle.**

Please contact the Student Services Office at dvminformation@ncsu.edu if you have any questions about these changes.

The academic professional program calls for two phases of education: a preclinical three-year phase and a clinical phase in the fourth year of training. The first through the third years of the professional program are concerned with a gradual progression from a basic science presentation to a more clinical application of veterinary science. Two summer-vacation periods are allowed in the first three years of the professional program.

- DVM Program (p. 966)

Doctor of Veterinary Medicine Program

The academic professional program calls for two phases of education: a preclinical three-year phase and a clinical phase in the fourth year of training. The first through the third years of the professional program are concerned with a gradual progression from a basic science presentation to a more clinical application of veterinary science. Two summer-vacation periods are allowed in the first three years of the professional program.

The clinical program at NC State Veterinary Medicine provides a heavy emphasis for actual “hands-on” clinical practice and is demanding both physically and mentally. Students select “focus areas” to increase their depth of training in their intended area of post-graduate activity, while still retaining a broad based veterinary education. There are ten focus areas from which to choose:

- Clinician Scientist
- Epidemiology, Public Health, and Public Policy
- Equine Practice
- Food Animal
- Laboratory Animal Medicine
- Mixed Animal Practice
- Pathology
- Small Animal Practice
- Small and Exotic Animal Medicine
- Zoological Medicine

In the first year, a DVM student will be able to describe the evolution, development, function and identification of normal microscopic and gross anatomy, explain the physiological and biochemical basis for common tests used in the diagnostic process, and learn how to effectively communicate in small groups in a professional veterinary context.

Course	Title	Hours
First Year		
Fall Semester		
VMC 910	Careers in Veterinary Medicine	1
VMB 911	Veterinary Anatomy I	5
VMB 912	Introduction to Clinical Problem Solving in Veterinary Practice	2
VMB 913	Veterinary Physiology and Microanatomy I	5
VMB 914	Histology and Cytology	2
VMC 914	Group Communication in Veterinary Medicine	1
VMP 910	Infection and Immunity 1	3
VMP 916	Health Maintenance and Animal Production I	1
	Hours	**20**
Spring Semester		
VMB 920	Small Group Problem Solving in Veterinary Medicine	1
VMB 921	Veterinary Comparative Anatomy	4
VMB 923	Veterinary Physiology and Microanatomy II	4
VMC 927	Introduction to Companion Animal Behavior	2
VMP 916	Health Maintenance and Animal Production I	1
VMP 920	Infection and Immunity 2	4
VMP 921	Problem Solving for Cases in Infectious Diseases and Immunity 1	2
VMC 937	Introduction to Physical Examination Skills-Small Animal	1
	Hours	**19**
	Total Hours	**39**

Course	Title	Hours
Second Year		
Fall Semester		
VMB 930	Anesthesiology	2
VMB 931	Veterinary Ethics and Animal Welfare	2
VMB 932	Veterinary Medical Decision Making	1
VMB 933	Veterinary Pharmacology I	3
VMB 936	Introduction to Radiology	1
VMC 932	Principles of Surgery	3
VMP 930	Infection and Immunity 3	3
VMP 931	Veterinary Pathology I	3
VMP 934	Problem Solving for Cases in Infectious Diseases & Immunity 2	2
VMP 936	Health Maintenance and Animal Production II	1
	Hours	**21**
Spring Semester		
VMB 943	Veterinary Pharmacology II	3
VMB 944	Veterinary Toxicology and Poisonous Plants	2
VMC 942	Principles of Medicine	2
VMC 943	Laboratory Animal and Zoological Species Health and Disease I	1
VMC 944	Introduction to Clinical and Professional Communication	1
VMP 936	Health Maintenance and Animal Production II	1
VMP 941	Veterinary Pathology II	4
VMP 942	Veterinary Clinical Pathology	3
VMP 945	Epidemiology & Public Health	3
	Hours	**20**
	Total Hours	**41**

Course	Title	Hours
Third Year		
Fall Semester		
VMB 952	Specialized Problem Solving in Veterinary Medicine	1
VMC 951	Companion Animal Medicine and Surgery I	4
VMC 952	Equine Medicine and Surgery	3
VMC 953	Laboratory Animal and Zoological Species Health and Disease II	3
VMC 956	Advanced Clinical and Professional Communication	1

VMC 957	Introduction to Clinical Practice	1
VMC 933	Theriogenology	2
VMP 956	Health Maintenance and Animal Production III	1
	Hours	**16**
Spring Semester		
VMB 960	Veterinary Radiology and Radiobiology	2
VMB 961	Success in the Clinics and Beyond	1
VMB 965	Veterinary Nutritional Health	2
VMC 961	Companion Animal Medicine and Surgery II	3
VMC 965	Advanced Principles of Surgery	1
VMP 962	Ruminant Medicine	3
VMP 964	Swine and Poultry Medicine	2
	Hours	**14**
	Total Hours	**30**

Fourth-year students must complete required and elective rotations that vary depending on the students' selected focus area (https://cvm.ncsu.edu/education/dvm/program/focus-areas/). Students must complete 43 credits in the senior year: 40 credits of clinical rotations and three credits in Clinical Conference. The clinic year consists of 24 blocks, two-to-three weeks in length, with up to four vacation blocks and three extramural experiences (Clinician Scientist, Epidemiology, & Food Animal Focus Areas have different extramural requirements). A total of 168 credit hours are required for graduation. Clinical Conference presentations are required of each senior.

The clinic scheduling process begins in fall of third year with information sessions with senior clinicians and/or clinical coordinators, Academic Affairs, and Students Services.

Code	Title	Hours	Counts towards
VMC 996	Advanced Exotic Animal Medicine	2	
VMC 959	Advanced Primate Medicine	2-4	
VMC 958	Advanced Prosimian Medicine	2	
VMP 975	Advanced Topics in Veterinary Anatomic Pathology	1-6	
VMB 977	Clinical Anesthesia Rotation	2	
VMC 998	Basic Wildlife Rehabilitation Medicine	2	
VMC 972	Clinical Small Animal Veterinary Cardiology	2	
VMB 978	Clinical Behavior & Nutrition	2	
VMC 995	Clinical Conference	1	
VMP 978	Clinical Pathology and Laboratory Medicine	2	
VMB 962	Clinician Scientist Research Experience	1-10	
VMC 983	Dermatology	2	
VMP 979	Epidemiology	2	
VMC 966	Equine Emergency and Critical Care	2	
VMC 978	Equine Lameness and Imaging	2	
VMC 979	Equine Medicine	2	
VMC 968	Equine Orthopedic Surgery and Lameness	2	
VMC 949	Equine Primary Care	4	
VMC 993	Equine Special Topics	2	
VMC 975	Equine General Surgery	2	
VMC 988	Exotic Animal Medicine	2	
VMC 946	Extramural Business Management Experience	2	
VMC 955	Extramural Experiences in Lab An Med	2	
VMP 994	Extramural Experience in Pathology	1-4	
VMC 994	Small Animal 4th Year Extramural Studies	1-6	
VMC 963	Extramural Experience in Zoological Medicine	2	
VMP 971	Food Animal Diagnostics for Disease Diagnosis, Control, and Population Surveilla	2	
VMP 976	Food Animal Pharmacology	2	
VMP 977	Autopsy/ Clinical Pharmacology	2	

VMP 974	Food Supply Veterinary Medicine	2
VMC 939	Small Animal Primary Care	2
VMC 981	Lab Animal Medicin	2
VMC 974	Equine Dentistry and Podiatry	2
VMC 986	Adv Com An Int Med	2
VMC 971	Comp Animal Med II	4
VMC 954	Companion Animal Medicine for Food Animal Students	2
VMC 984	Intro Clin Neuro	2
VMC 980	Vet Clini Oncology	2
VMC 982	Ophthalmology	2
VMP 982	Poultry Health Management I	2
VMP 983	Poultry Health Management II	2
VMC 948	Clinical Rotation in Veterinary Radiation Oncology	2
VMB 976	Radiology Rotation	2
VMC 997	Raptor Medicine and Rehabilitation	2
VMC 930	Rehabilitation and Mobility Clinical Rotation	2
VMP 970	Ruminant Health Management I	2
VMP 972	Ruminant Health Management II	2
VMP 987	Ruminant Topics	2
VMC 950	Sea Turtle Medicine and Rehabilitation	2
VMC 960	Small Animal Emergency Service	2
VMC 973	Small Animal Surgery (Topics Include: Small Animal General Surgery; Small Animal Orthopedic Surgery)	2
VMP 973	Special Topics in Epidemiology	2
VMC 941	Special Topics in Theriogenology	2
VMP 984	Swine Health Management I	2
VMP 985	Swine Medicine & Production II	2
VMC 940	Clinical Theriogenology	2
VMB 976	Radiology Rotation (Ultrasound)	2
VMC 976	Veterinary Critical Care	2
VMP 999	Extramural in Vet International Programs	2
VMC 964		2
VMC 989	Zoological Medicine	4
VMC 947	Practice Management: Evaluating the workflow, services, and financial performance of a hospital	2
VMP 990	Extramural Experiences - Large Animal (Topics include: Extramural Experiences in Equine; Extramural Experiences in Food Animal/ Mixed Animal)	2

Course Descriptions

The course descriptions are arranged first in alphabetical order according to course prefix reflecting the department or discipline of the course. Some courses are cross-listed, indicating that they are offered in two or more departments or disciplines. Within each of the prefix groups, the course descriptions are arranged by course number. Numbers 100-299 are courses intended primarily for freshmen and sophomores. Numbers 300-499 are courses intended primarily for juniors and seniors; numbers 490-498 are seminar, project, or special topics courses; number 499 is for undergraduate research.

Courses numbered 500 - 600 are taught at the Masters level and most are available to advanced undergraduates. Doctoral courses are numbered 700 - 899. Graduate courses numbered at the 500 and 700 levels are letter graded (A+ through F), while 600 and 800 level courses are S/U graded. Courses regularly letter graded (A+ through F) may not be taken for S/U grading by graduate students. Courses numbered in the 900 series are open to College of Veterinary Medicine students.

A typical course description shows the prefix, number, and title followed by prerequisite, credit and offering information. Prerequisites are courses or levels of achievement that a student is expected to have completed successfully prior to enrolling in a course. Corequisites are courses which should be taken concurrently by students who have not previously completed the corequisites. Prerequisites or corequisites for a given course may be waived by the instructor of the course or section. It is the student's responsibility to satisfy prerequisites, or obtain from the instructor written waiver of prerequisites, for any course in which he or she may enroll. Failure to satisfy prerequisites may result in removal from enrollment in the course. Consent of the department is required for all practicum and individual special topics or special problems courses as well as internships and thesis or dissertation research. Some courses also have restrictive statements, such as "Credit in both MA 141 and MA 131 is not allowed." Restrictive statements for a given course may be waived only by a college dean.

An example of credit information is: **ACC 200 Introduction to Managerial Accounting** *3.*The 3 indicates the number of semester hours credit awarded for satisfactory completion of the course. Some courses are offered for variable credit, and a listing of 1-6 indicates that from one to six semester hours of credit may be earned as arranged by the department writing the course.

A

B

C

D

E

Academy of Data Science (DSC)

DSC 495 Special Topics in Data Science (1-6 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings or for offering new courses on a trial basis. Students may repeat this course under a different topic.

Typically offered in Fall, Spring, and Summer

Accounting (ACC)

ACC 200 Introduction to Managerial Accounting (3 credit hours)
Analysis of accounting data that are useful in managerial decision making and in the control and evaluation of the decisions made within business organizations. An introduction to basic models, financial statement analysis, cost behavior analysis and cost control procedures.

Prerequisite: ACC 210
Typically offered in Fall, Spring, and Summer

ACC 210 Concepts of Financial Reporting (3 credit hours)
Financial reporting concepts, the accounting information generating process, reporting practices, financial statement preparation, and the interpretation and analysis of financial statements. Basic accounting principles and concepts, the accounting cycle, income measurement, and internal controls.

Typically offered in Fall, Spring, and Summer

ACC 220 Introduction to Managerial Accounting (3 credit hours)
The course is designed to provide students with a basic understanding of managerial accounting concepts. Students will analyze accounting data that are useful in managerial decision making and in the control and evaluation of the decisions made within business organizations. Credit will not be allowed for both ACC 220 and ACC 200.

Prerequisite: ACC 210
Typically offered in Fall, Spring, and Summer

ACC 230 Individual Income Taxation (3 credit hours)
The course focuses on the fundamental concepts of individual income taxation. It is suitable for business and nonbusiness students. Students will apply tax law learned in the course to a real world setting by conducting tax research and preparing actual income tax forms and returns.

Typically offered in Spring and Summer

ACC 280 Survey of Financial and Managerial Accounting (3 credit hours)
This course covers the basic principles and concepts of financial and managerial accounting. Students will learn about the role of accounting in business including how to prepare basic financial statements and how accounting information is used by: (1) external stakeholders (i.e., stockholders, creditors and government) to evaluate the financial performance of an organization; and (2) internal users (management) to fulfill the planning, control and performance evaluation functions.

This course cannot be used to satisfy degree requirements for the accounting degree or the business degree within the Poole College of Management. This course does not substitute for either ACC 210 or ACC 220.
Typically offered in Fall, Spring, and Summer

ACC 295 Special Topics in Accounting (1-6 credit hours)
Presentation of accounting material at the 200-level not normally available in regular course offerings, or offering of new courses on a trial basis. Course may be taken multiple times only if topic is different.

Typically offered in Fall, Spring, and Summer

ACC 310 Intermediate Financial Accounting I (3 credit hours)
This course introduces the conceptual framework of financial accounting and process of developing professional standards along with the foundations of accounting and reporting systems. Students are provided an in-depth analysis of the income statement, the balance sheet, the statement of cash flows, and the reporting process. The course also covers measurement and reporting issues for major categories of assets on the balance sheet.

Prerequisite: ACC 210 with a C+ or better
Typically offered in Fall, Spring, and Summer

ACC 311 Intermediate Financial Accounting II (3 credit hours)
A continuation of topics introduced in Intermediate Financial Accounting I [ACC 310]. Topics include the Statement of Cash Flows, the Statement of Stockholders Equity, accounting for investments in equity and debt securities, liabilities, leasing, pension and post-retirement benefit plans, deferred income taxes, revenue recognition, and various forms of stock-based compensation plans.

Prerequisite: ACC 310 with grade of C- or better
Typically offered in Fall, Spring, and Summer

ACC 330 An Introduction To Income Taxation (3 credit hours)
Basic income tax principles and procedures (including research and planning) with an emphasis on all types of entities and business transactions. Exposure to a range of tax concepts within the framework of financial reporting.

Prerequisite: ACC 210 with a grade of C- or better
Typically offered in Fall and Spring

ACC 340 Accounting Information Systems (3 credit hours)
Accounting is an information system that supports business processes and decision-making through record-keeping, reporting, and control. This course covers transaction cycles, related internal controls, and the use of computer applications (Microsoft Excel and Access, SAP, and Sage 50) to collect, organize, analyze, and report accounting data. Students will design, develop, and implement a database in this course.

Prerequisite: BUS 340 and ACC 210 with a grade of C- or better
Typically offered in Fall, Spring, and Summer

ACC 411 Business Valuation (3 credit hours)
Conceptual framework of how businesses work, value generation and reporting. Interpretation of financial statements and their use in valuation of the firm.

Prerequisite: ACC 210, BUS 320, and (BUS/ST 350 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

ACC 420 Cost Accounting for Effective Management (3 credit hours)
Cost Accounting for Effective Management focuses on the development and use of managerial accounting information in planning, control, and decision making activities and in designing and implementing business strategies. Integration of performance measurement and cost control with corporate strategy.

Prerequisite: ACC 210 with C- or better and ACC 200 or ACC 220 with a C- or better
Typically offered in Fall and Spring

ACC 440 Enterprise Resource Planning Systems (3 credit hours)
Enterprise resource planning (ERP) systems are business systems that integrate and streamline data across the company into one complete system that supports the needs of the entire organization. Course content includes ERP marketplace, ERP technology, business process redesign and process mapping, planning, package selection, implementation and operation of ERP systems, ERP module functionality, and visualization of ERP data. As NCSU is a member of the SAP University Alliance, you will have the opportunity to obtain hands-on experience with the SAP ERP system and SAP data analytics software. Credit will not be allowed for both ACC 440 and MBA 515.

Prerequisite: BUS 340
Typically offered in Fall and Spring

ACC 450 Auditing and Assurance Services (3 credit hours)
Introduction to auditing practice and theory. Focuses on developing skills for interpreting business strategies and identifying related business risks that may impact the risk of material misstatement in financial statements, describing internal control solutions to those risks, identifying evidential sources, and designing strategies to provide assurance about the financial statements, internal control over financial reporting, and other business information.

Prerequisite: ACC 311 with a C- or better and ACC 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall, Spring, and Summer

ACC 451 Internal Auditing (3 credit hours)
An overview of the theory, practice, and design of internal audit activities. Examine industry standards and the professional practices of the internal audit. Evaluate risk and controls related to operations, information technology, fraud, and compliance. Design and manage assurance activities. Assess audit evidence and communicate engagement results.

Prerequisite: ACC 210 with grade of C- or better and ACC 340
Typically offered in Fall and Spring

ACC 458/BUS 458 Analytics: From Data to Decisions (3 credit hours)
Students will develop and apply their data analytics skills by analyzing case studies built around real business problems and real data. Case studies are designed around the full analytics lifecycle which encompasses the business problem, data, analysis, and decision. Students will learn to identify and explain business problems that can be addressed with analytics. They also will learn to determine which analytic methods are best suited to solve particular problems and will evaluate the impact of applying analytic methods. Finally, they will learn to explain the results of an analytic model and how those results impact the business "bottom line.

Prerequisite: BUS 351
Typically offered in Fall and Spring

ACC 459 Analytics in Accounting and Finance (3 credit hours)
To enhance the understanding and integration of financial statement preparation, management reporting, analytics, and forecasting necessary to control and improve performance. The course is designed to work through the major process life-cycles and tools deployed within accounting and finance organizations that support the information needs that executives depend on for decisions that create competitive advantage. The course reflects, through simulation and practical application, the role that Corporate Finance plays in support of a firm's strategies and business operations. The course is designed for students with career interests that include operational accounting, financial analysis, financial planning, corporate finance, information systems, business and operations management, public accounting, and consulting.

Prerequisite: ACC 311 and BUS 351
Typically offered in Fall and Spring

ACC 460 Governmental and Nonprofit Accounting (3 credit hours)
Accounting and reporting for state and local governments, including budgeting and financial analysis. Accounting for nonprofit organizations emphasizing voluntary health and welfare organizations.

Prerequisite: ACC 210
Typically offered in Fall only

ACC 495 Special Topics in Accounting (1-6 credit hours)
Presentation of material not normally available in regular course offerings, or offering of new courses on a trial basis.

ACC 498 Independent Study in Accounting (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with the associate department head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ACC 499 Internship in ACC (1-6 credit hours)
A full-time accounting-related professional internship. Participants will communicate with instructor weekly over the course of the internship to discuss progress and insights. A post-internship interview and paper is also required. Internships may vary in duration from 8 to 15 weeks. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department. This form can be obtained from the Accounting department or from the Poole Office of Undergraduate Programs.

Prerequisite: Completion of ACC 310 and ACC 311. Restricted to accounting majors. Departmental approval required.
Typically offered in Spring and Summer

ACC 508 Advanced Commercial Law (3 credit hours)
A study of law and regulation as a structure in which to develop business goals and strategies. Students will examine those elements of law and regulation that are a context for ethical business behavior. Students will also study the provisions oflaw and regulation including case-law that must be followed as a part of the strategic planning process and in the process of implementing business methods and procedures.

Prerequisite: MAC Program
Typically offered in Spring only

ACC 510 Advanced Financial Accounting (3 credit hours)
Study of complex financial reporting topics affecting U.S. corporations. Focus on the underlying business rationales associated with transactions/events triggering the complex financial reporting issue. Topics will include international accounting, consolidations, mergers and acquisitions, derivatives, SEC reporting, and other emerging issues.

Prerequisite: MAC Program
Typically offered in Spring and Summer

ACC 519 Applied Financial Management (3 credit hours)
A study of key business decision made and tools used by CFOs in their executive management roles. Students will focus on managerial analysis tools (e.g., business plans; budgeting) and finance issues (e.g., funding alternatives, treasury, and cash management). The course will include management skills related to the CFO, such as negotiations, leadership, delegation, interactions with boards, etc.

Prerequisite: MAC Program
Typically offered in Fall and Summer

ACC 520 Advanced Management Accounting (3 credit hours)
A study of how accounting and operating information is used in management planning and decision making. Students will apply advanced costing models and design and evaluate management decision making information systems. Topics will include issues that are appropriate for consideration by executive management and the board of directors.

Prerequisite: MAC Program
Typically offered in Spring only

ACC 530 Advanced Income Tax (3 credit hours)
A study of the tax consequences of business, financial, and personal wealth-planning transactions. Students will examine the economic or legal context of transactions along with the non-tax motives of the transacting parties. The course will consider the efficiency of tax strategies in terms of their impact on net cash flows and other financial reporting effects.

Prerequisite: MAC Program
Typically offered in Fall only

ACC 533 Accounting and Tax Research (3 credit hours)
A study of research methods, procedures and tools used to develop solutions to technical and policy-oriented business problems. Students will consult various competent authorities on taxation, accounting, auditing, and general business in the development of business problem solving techniques.

Prerequisite: MAC Program
Typically offered in Fall only

ACC 540 IT Risks and Controls (3 credit hours)
A study of how business strategies use information technology (IT) as an efficient enabler of redesigned core business processes. Students will focus on how the use of IT affects risk management by eliminating certain risks and introducing others. Students will examine IT control solutions used to address IT risks and will address issues affecting assurance engagements related to IT systems.

Prerequisite: MAC Program
Typically offered in Fall only

ACC 545 Information Technology Audit (3 credit hours)
Organizational managers and board members recognize the importance of effectively managing information technology (IT) assets - to meet business objectives and to thoughtfully manage IT related business risks. This course examines the key principles related to auditing information technology processes and related controls, and is designed to meet the increasing needs of audit, compliance, security, and risk management professionals. There are no required prerequisites for this course, however, it is helpful to have had ACC540.

R: PCOM Graduate Students
Typically offered in Spring only

ACC 550 Advanced Auditing (3 credit hours)
A study of the impact of business risks on the design and performance of audit procedures to detect material misstatements in financial statements. Students will be exposed, through a case-based approach, to significant business issues related to audit planning, risk assessment and auditor response, corporate governance, reporting, and other significant business issues affecting audit professionals in their first years of employment.

Prerequisite: MAC Program
Typically offered in Spring and Summer

ACC 560 Tools for Tax Analytics (1 credit hours)
In this course we will teach the skills needed to identify many of the situations where the method of accounting for tax purposes for revenue and expense differs from that used in financial accounting. Focus will be placed on analyzing and outlining those differences in a concise and visual manner in order to assist upper management understand the tax implications of their operational and financial accounting decisions. To assist us in this, we will utilize analytic tools that are regarded as required knowledge by today's tax departments. After a brief review of basic analytics skills, we will focus on more advanced analytic tools which will be reinforced with tax-focused examples and assignments specifically to allow the student to apply these featured analytics topics in tax situations. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 561 Database Management in Tax (1 credit hours)
In this course, we will teach the skills needed to understand and identify many aspects of the state income tax apportionment process. Focus will be placed on the calculations and analyses required to present the state and local tax information in such a manner as to assist upper management in the business-expansion decision-making process. The tax apportionment process requires a solid understanding of database management. To assist us in this, we will utilize database management tools that are considered required knowledge by today's tax departments. After a brief review of introductory database management topics, we will focus on more advanced database management topics which will be reinforced with tax-focused examples and assignments specifically created to allow students to see these featured database management topics when applied to tax scenarios. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 562 Forecasting Effective Tax Rates and Scenario Analysis - Introduction (1 credit hours)
In this course we will examine the different definitions of book income and taxable income with a focus on accounting for income taxes under ASC 740. Students will contrast the principles of conservatism reflected by generally accepted accounting principles and by the tax law. In addition, students will learn how to utilize regression analysis and scenario analysis to provide additional insights about these tax topics and to forecast future effective tax rates. Tax-focused examples and assignments created specifically to allow the student to apply regression analysis in tax situations will reinforce the technology covered in this course. In addition to utilizing regression analysis, this course will examine tax technical subjects to provide the student sufficient knowledge to complete the examples and assignments. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 563 Forecasting Effective Tax Rates and Scenario Analysis - Advanced Application (1 credit hours)
In this course we will continue to examine the different definitions of book income and taxable income but the primary focus will be on examining tax disclosures in financial statements and gaining an understanding of how they can be used for financial statement analysis. We will also carry out regression and scenario analysis to provide additional insights into disclosed tax information. These types of insights are of significant benefit and often utilized in decision making by company management and financial analysts employed by investment funds. The skills learned will be reinforced with tax-focused examples and assignments created specifically to allow the student to apply regression and scenario analysis in tax situations. In addition to utilizing regression and scenario analysis, this course will examine tax technical subjects to provide the student sufficient knowledge to complete the examples and assignments. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 562
Typically offered in Fall, Spring, and Summer

ACC 564 Project Management and Process Documentation in Tax (1 credit hours)
In this course we will focus on tax project management and tax process documentation skills. Students will develop an understanding of project management in the context of a tax provision process assessment for a hypothetical company, Project Clarity. Students will also develop an understanding of internal control best practices and how they apply to a corporate tax department's tax provision process. In addition, they will develop the skills necessary to identify improvements within the tax provision process and learn how to prepare a flow chart of the process. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 565 Visual Analytics in Tax (1 credit hours)
We will teach visual analytics to enhance the value and quality of the tax information provided to decision makers in an organization. All aspects of tax including planning, tax provision work, compliance and controversy work will be covered. The focus will be on state and local nexus, sales and use taxes, and foreign bank account reporting (FBAR) requirements. Students will also learn to manipulate data into a visual front end so that those reviewing the data with the purpose of decision-making will have an easier time reading and interpreting the data analytics. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 560
Typically offered in Spring only

ACC 566 Database Management Applications in Tax (1 credit hours)
In this course, we will teach the skills needed to understand and identify more advanced aspects of the state income tax apportionment process, including combinations and consolidations. The student will gain knowledge in the areas of data query language, data definition language, and data manipulation language using structured query language. Students will learn more advanced tools to retrieve, define, store, and update state income tax data in a database management program. These tools will be reinforced with taxÂ focused examples and assignments specifically created to allow the student to see these featured topics when applied to tax scenarios. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 561
Typically offered in Fall, Spring, and Summer

ACC 569 Advanced Visual Analytics in Tax (1 credit hours)
Visualization helps us see and understand the story the data tells us. In this course, students will be introduced to an interactive data visualization tool which allows users to select specific tax information and customize the format of visualization to assist in the management decision making process. Students will learn how to use this tools to increase the relevance and usefulness of tax data. The software will be used in specific tax-related applications, including foreign bank account reporting exposure and compliance, country by country reporting, state income tax exposure, compliance data and risk analysis. An undergraduate degree and basic tax and accounting knowledge required.

P: ACC 565
Typically offered in Fall, Spring, and Summer

ACC 570 Data Security and Warehousing in Tax (1 credit hours)
The course is focused on the importance of data security with respect to all financial data but specifically tax data. It also covers the area of tax data warehousing from the standpoint of the differing financial detail needs of a tax department and the benefits of utilizing a Cloud solution. Students will gain insight into data securing learning protection of networks and cryptography with emphasis on the data security in a tax focused environment. An undergraduate degree and basic tax and accounting knowledge required.

R: Graduate Standing or PBS
Typically offered in Fall, Spring, and Summer

ACC 580 Data Analytics in Accounting (3 credit hours)
This course provides an opportunity to learn and apply various data analytics techniques to a business case to support management's decision making. This course utilizes analytics tools and technology in an advisory context. Specifically, you will be learning and using Excel, Access and PowerBI tools, as well as Word to summarize your analysis. Soft skills are essential in today's environment. This course also helps to strengthen these skills including written communication (formal and informal), critical thinking and data analytics.

R: MAC or MBA Program
Typically offered in Fall, Spring, and Summer

ACC 588 Special Topics in Accounting (1-6 credit hours)
Course objectives dependent upon unique circumstances motivating offering of course. Timely curriculum innovation the primary motivation. Departmental consent required.

Typically offered in Fall and Spring

ACC 600 Managerial and Career Effectiveness (1 credit hours)
Knowledge and skills needed to advance professional accounting career. Strategic communication of self and ideas in professional and classroom settings. Diagnosis of organizational culture. Impression management and appropriate business behavior. Leadership of individuals, group dynamics, and team building.

Prerequisite: MAC Program
Typically offered in Fall only

ACC 630 Independent Study (1-3 credit hours)
Advanced topics not otherwise included in curriculum by advanced graduate students on a tutorial basis. Determination of credits and content by participating faculty in consultation with Director of Graduate Programs. Departmental consent required

Typically offered in Spring only

Adult & Higher Education (EAC)

EAC 301 Introduction to Leadership Fundamentals (3 credit hours)
This course will provide basic understandings of the components of leadership that can be applied to their current and future leadership experiences on campus or in their individual communities, and to provide a model of critical reflection for those applications.

Prerequisite: Sophomore standing, Junior standing, or Senior standing
Typically offered in Fall and Spring

EAC 496 Special Topics in Adult Learning and Leadership (1-6 credit hours)
Exploration of specialized areas and topics of current interest in adult learning and leadership.

EAC 517 Current Issues in Higher Education (3 credit hours)
Examination of important social, political and economic issues affecting present and future operation of colleges and universities in America. Graduate standing or PBS status required.

Typically offered in Spring only

EAC 522 Foundations of Adult Education (3 credit hours)
Introduction to the field of adult education as an area of graduate study and practice. It is intended for those who have experience or desire to work with adult learners or with organizations that serve adult learner populations.

Typically offered in Fall only

EAC 532 Health Care Delivery Systems and Environments (3 credit hours)
Organization of health care delivery system, services and recourses. Focus on major social, economic, political and professional factors contributing to shaping the system and influencing change. Analysis of organizations and environments in regard to demand for health personnel and the implications for health occupations education.

Prerequisite: Graduate standing
Typically offered in Summer only

EAC 536 Issues and Trends In Education For the Health Professions (3 credit hours)
An analysis of educational and social factors influencing change in health professions education. Problems of student selection and program articulation, and implications for health occupations education and health services of recent legislation impacting health care.

Prerequisite: Graduate standing
Typically offered in Spring only

EAC 538 Instructional Strategies In Adult and Higher Education (3 credit hours)
Forms of instruction appropriate for the teaching of adults. Special emphasis upon methods for maximum involvement of the adult learner. Relevant concepts, theories and principles for selection, utilization and evaluation of instructional strategies with focus on integration of theory into practice. Development of student proficiency in use of applicable teaching techniques for adult and community college education through participation in classroom exercises.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

EAC 539 Teaching in the Online Environment (3 credit hours)
The course focuses on exploring the issues and considerations in online teaching and introduce students to some of the tools involved in the process. Students will develop strategies for teaching online and for managing the online classroom.

Typically offered in Fall and Spring

EAC 540 Foundations of Higher Education and Student Affairs (3 credit hours)
Examines knowledge that guides professional practice in higher education and student affairs, such as: history of higher education, professional development practices, student characteristics, group process, and helping and advising skills. Programmatic applications are emphasized through class assignments.

Typically offered in Fall only

EAC 541 Administration and Finance of Student Affairs (3 credit hours)
Examination of the role of student affairs in higher education institutions to include: organizational structures, leadership and decision-making, planning and budgeting, staffing and supervision.

Prerequisite: EAC 540
Typically offered in Spring only

EAC 542 Student Characteristics and the College Environment (3 credit hours)
Study of the history and philosophy of student affairs, the impact of college on students and current issues of concern to students and student affairs professionals. Good practices of student affairs in the context of student learning are identified and current literature is reviewed.

Typically offered in Spring only

EAC 543 Student Development Theory (3 credit hours)
Gain an understanding of the major student development theories and emerging professional literatures in this area. Provide opportunities for students to develop skills in applying student developmental theory to specific student affairs settings, issues, and populations.

Prerequisite: EAC 540
Typically offered in Fall only

EAC 544 History of the College Student Experience in the United States (3 credit hours)
This course will review the history of higher education in the United States from the colonial period to the present with particular attention to the ways in which shifting policies and practices in higher education institutions have affected the college student experience and the student affairs profession. Graduate standing or PBS status required.

EAC 545 Higher Education Masters Professional Seminar (3 credit hours)
Emphasizes application of concepts and theories learned in previously completed coursework to understand and analyze current issues facing student affairs professionals. Focuses particularly on the job search process and transition out of graduate school. Facilitates the transition from student to full-time student affairs professional through critical examination, synthesis, integration, and practical application of prior and concurrent coursework.

R: EAC 540 and EAC 542 and EAC 543
Typically offered in Spring only

EAC 551 Research in Adult & Higher Education (3 credit hours)
Introduces master's students studying adult learning and higher education to two major research paradigms in education, quantitative and qualitative research, and to the research literature of disciplines related to the education of adults. Students will learn how to distinguish between research and non-research materials, and how to evaluate quantitative and qualitative research studies on the basis of their research merit.

Prerequisite: Master's students in ACCE
Typically offered in Fall, Spring, and Summer

EAC 552 College Student Retention (3 credit hours)
Exploration of college student retention theories, relevant research, and exemplary retention programs. Examines student retention and completion within four-year colleges and universities as well as student persistence within and transfer from community colleges.

Typically offered in Spring only

EAC 555 Ethics in the Workplace and Education (3 credit hours)
Introduction to ethics and social responsibility in adult education, training, higher education and other work and educational environments in a global setting. Emphasis on addressing moral and ethical issues in the workplace and education by applying critical thinking and analysis processes to ethical dilemmas. Graduate standing or PBS status required.

Typically offered in Fall only

EAC 556 Organization Change in HRD: Theory & Practice (3 credit hours)
Organization Change in Human Resource Development provides an introduction to the theory and practice of change within the context of adult education programs, other organizations, communities and societies. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 559 The Adult Learner (3 credit hours)
An inquiry into the characteristics and background, learning processes, motivation and participation of adult learners in a variety of educational contexts. Emphasis on adult learning theories, models, principles and their application to educational design and delivery.

Typically offered in Fall, Spring, and Summer

EAC 560 Assessment & Evaluation in Adult & Higher Education (3 credit hours)
Introduces students to assessment and evaluation principles and practices from a range of perspectives. Covers uses and limitations of a broad range of assessment and evaluation approaches in adult education settings, with particular focus on college and university teaching.

Typically offered in Spring and Summer

EAC 580 Designing Instructional Systems in Training and Development (3 credit hours)
Introduction to instructional design models including needs assessment, systematic training design and development techniques and proactive strategies for evaluating training programs. Instructional design issues of work-based training, learner characteristics and effects of technology on instructional design, implementation and evaluation processes. Graduate standing or PBS status required.

Typically offered in Fall, Spring, and Summer

EAC 581 Advanced Instructional Design in Training and Development (3 credit hours)
In-depth analysis of instructional systems design (ISD) theory and practice using professional competency models. Organizational training requirements, development of performance objectives and measures, design of instructional materials, and address of evaluation issues in training programs in business and industry. Research and development of instructional design projects relating to ISD process and model. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 582 Organization and Operation Of Training and Development Programs (3 credit hours)
Overview of occupational education practice in business and industrial settings. Presentation of roles common to training and development specialists, including managerial concerns related to organization, operation and financial training and development programs.

Typically offered in Fall only

EAC 583 Needs Assessment and Task Analysis in Training and Development (3 credit hours)
Current needs assessment and task analysis methods and techniques used in business and industrial settings. Development of comprehensive needs assessment plans for diagnosing and documenting human performance deficiencies/improvement opportunities through training programs in business settings. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 584 Evaluating Training Transfer and Effectiveness (3 credit hours)
Philosophy, strategies, and procedures for evaluating effectiveness of training programs. Development of multi-level evaluation plan for use with training program to study outcomes and process of training from perception to organizational impact. Design of evaluation methods and instruments, data collection, analysis, and interpretation for each level of evaluation emphasizing transfer of training. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 585 Integrating Technology into Training Program (3 credit hours)
Appropriate technologies for design and delivery of effective training programs. Performance-based training models for distance and individualized learning through audio, video, computer-based, and multimedia technologies. Planning decisions for selecting/developing appropriate technologies to support specific training outcomes, adult learner characteristics, and organizational training resources. Graduate standing or PBS status required.

Typically offered in Fall, Spring, and Summer

EAC 586 Methods and Techniques Of Training and Development (3 credit hours)
Methods and techniques common to model occupational education programs in business and industrial settings. Focus on design and evaluation of effective learning programs and instructional methodologies. Graduate standing or PBS status required.

Typically offered in Fall and Spring

EAC 595 Special Topics (3-6 credit hours)
Typically offered in Fall, Spring, and Summer

EAC 602 Seminar In Adult and Higher Education (1-3 credit hours)
Identification and scientific analysis of major issues and problems relevant to adult education or higher education. Course credit at the master's level through active student participation in a formal seminar and scientific appraisal and solution of a selected problem. Student acquisition of a broad perspective of issues confronting adult educators and experiences in scientific analysis and solution of specific issues.

Prerequisite: Graduate standing

EAC 624 Topical Problems In Adult and Community College Education (1-3 credit hours)
Study and scientific analysis of problems in adult education and preparation of a scholarly research type of paper. Credits Arranged.

Prerequisite: Graduate standing or PBS status

EAC 630 Independent Study in Adult and Community College Education (1-3 credit hours)
Independent study for master's students in Adult and community College Education.

Typically offered in Fall, Spring, and Summer

EAC 651 Internship In Adult and Community College Education (1-9 credit hours)
Utilization of the participant-observer role with required participation in selected educational situations. Emphasis upon observational skills' development, the recording of relevant observations through written journals, analysis of experiences identifying critical incidents and projection of events and consequences. Student development and selection of possible alternative courses of action in various situations and evaluation of the consequences of the selected course of action.

Prerequisite: Nine hrs. in graduate level courses
Typically offered in Fall, Spring, and Summer

EAC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EAC 692 Research Projects In Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Choice of research on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: EAC 732
Typically offered in Fall, Spring, and Summer

EAC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EAC 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EAC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

EAC 699/ECD 699/ECI 699/ELP 699/EMS 699/EOE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Spring only

EAC 700 Community College and Two-Year Postsecondary Education (3 credit hours)
Comprehensive community colleges and technical institutes and the state systems of which they are part: underlying concepts, design of educational needs to be serve, role in meeting these needs, historical development, issues in establishment and operation of state systems and individual institutions, unresolved issues and emerging trends.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

EAC 701 Administrative Concepts and Theories Applied To Adult and Community College Educ (3 credit hours)
For persons interested in building more consistent philosophy of educational administration, extension and strengthening of understanding of administrative concepts and processes, improved comprehension of theoretical and research foundations upon which administrative processes predicated, and increased ability for application of administrative concepts, theories and principles to management of complex education system.

Prerequisite: EAC 787 or a comparable course(s) on organizational theory
Typically offered in Spring only

EAC 703 The Programming Process In Adult and Community College Education (3 credit hours)
Principles and processes in programming, including basic theories and support of concepts in programming process. Attention to general programming framework, organizational needs and program roles of both professional and lay leaders.

Prerequisite: Graduate standing
Typically offered in Summer only

EAC 704 Leadership In Higher and Community College Education (3 credit hours)
Issues and concepts of leadership development and practice in two- and four-year colleges and universities; interpretation and communication of institutional values and understanding of organizational processes. Attention to role of organizational culture in management improvement and institutional performance in higher education institutions.

Typically offered in Summer only

EAC 705 Group Process In Adult and Higher Education (3 credit hours)
Application of research and theory in small group behavior to administration and teaching in adult and higher education settings. Opportunities for participant experience of various aspects of group behavior and practice of group leadership skills applicable to various group situations.

EAC 706 The College and University Presidency (3 credit hours)
Promotion of understanding of many facets of the college and university presidency. Investigation and analysis of college and university from the perspective of students's own careers and from the literature on the presidency. The president as institutional leader.

Prerequisite: EAC 700 or EAC 716
Typically offered in Spring only

EAC 707 The Politics Of Higher Education (3 credit hours)
Differing and changing perceptions of role of higher education in American society; politics of competition for priority of attention and resources; organizational alternatives in its control; relevant elements in structure and processes of government. References to other societies.

Prerequisite: Graduate standing or Management Development Certificate Program and six sem. hrs. of 500-level course work

EAC 708 Continuing Education for the Professions (3 credit hours)
Theoretical and research literature related to continuing education for the professions. Examination of role of educator in providing and managing continuing professional education.

Prerequisite: EAC 703, 759
Typically offered in Summer only

EAC 711 Reflective Practice and Research Inquiry (3 credit hours)
Initial doctoral seminar to enhance understanding of critically reflective practice, doctoral scholarly inquiry and current issues and debates in adult education scholarship and research.

Typically offered in Fall only

EAC 712 The Change Process in Adult Education (3 credit hours)
Provides an introduction to theory and practice of change within the context of adult education organizations, communities, and societies. Emphasis on theory and practice of change in adult education and training and developmental contexts.

Prerequisite: Adult Education Doctoral student
Typically offered in Spring only

EAC 716 History Of Higher Education In the United States (3 credit hours)
History of higher education from colonial period to the present. Emphasis on influence of philosophic, political, social and economic forces upon function and structure of higher education.

Prerequisite: Six hrs. of grad. ED courses
Typically offered in Fall only

EAC 730 Foundations of Adult, Higher, and Human Res Education (3 credit hours)
An inquiry into the characteristics and background, learning processes, motivation and participation of adult learners in a variety of educational contexts. Emphasis on adult learning theories, models, principles and their application to educational design and delivery. Doctoral status required.

Typically offered in Fall only

EAC 731 Technology in Adult, Higher, and Human Resource Education (3 credit hours)
Introduces the students to the role of technology in education. Positive and critical aspects will be addressed. Draws on theory and practice from numerous disciplines, including: adult education; distance education; educational, instructional and communication technologies; and, the teaching and learning sciences. Analysis of how education in the workplace, higher education and adult/community contexts is being transformed by technology. Evaluation of the complex interrelationships among education, learning and technology. Doctoral status required.

Typically offered in Fall only

EAC 732 Globalization Intl Issues Adult Higher Hum Res Ed (3 credit hours)
This core course focuses on globalization and its implications for the study and practice of adult, higher, and human resource education, as well as the evolution and increase of diverse international perspectives in the scholarship and policy arenas viewed from an interdisciplinary perspective. Doctoral status required.

Typically offered in Spring only

EAC 737 The Extension and Public Service Function In Higher Education (3 credit hours)
Examination of background, history, philosophy and contemporary nature of extension and public service function of institutions of higher education in U.S. Emphasis on adult education role of public and private universities and colleges. Specific focus on: general extension, industrial extension, engineering extension, cooperative extension and continuing education.

Prerequisite: EAC 710
Typically offered in Spring only

EAC 743 Adult Development and Learning (3 credit hours)
This course examines key theories and research on the physical, and related socio-cultural changes across the adult lifespan. Special emphasis in this course will be on the intellectual and psycho-social aspects of adult development. Key implications for educational programs and services, as well as research investigations of adults in learning environments, will be explored.

Prerequisite: EAC 739
Typically offered in Spring only

EAC 749 Finance in Higher Education (3 credit hours)
Examination of theory, research, practices and issues in development and management of financial resources in higher education.

Typically offered in Fall only

EAC 750 The Environment for Learning In Adult and Higher Education (3 credit hours)
Planning and management of the physical environment for effective adult learning. Applicability of concepts and theories of learning and teaching environment to needs analysis, planning, resource development, cooperation with professional designers,and construction, operations, conservation and maintenance of educational facilities, equipment and grounds.

Prerequisite: EAC 700 and Graduate standing or PBS status

EAC 759 Adult Learning Theory (3 credit hours)
Requisite involvement and undergirding of principles in adult education programs including theories and concepts. Emphasis on interrelationship of nature of adult learning, the nature of the subject matter and setting for learning occurrence. Applicability of relevant principles and pertinent research findings to adult learning.

Prerequisite: Six semester hours in ED
Typically offered in Spring only

EAC 760 Diversity in Higher Education (3 credit hours)
This course uses a multicultural competence framework to explore issues of diversity and social justice in higher education and the broader society. Issues of privilege, power, and oppression are explored and discussed in depth as well as the intersection of multiple identities and oppressions.

Typically offered in Spring only

EAC 761 Gender Studies in Adult Higher Education (3 credit hours)
Explores topics and issues related to the experiences of men and women in adult and higher education. This includes examination of meanings and applications of diverse feminisms, particularly as they apply to study of gendered patterns of student development in higher education.

Typically offered in Spring only

EAC 762 Spirituality in Higher Education (3 credit hours)
With a focus on spirituality and religion in higher education, this course provides an introduction to an emerging area of research and practice among higher education administrators and scholars. The course encourages the development of knowledge and skills to understand and engage in religious and worldview diversity in postsecondary educational contexts.

Typically offered in Spring only

EAC 765 Current Issues in Adult Education (3 credit hours)
Analysis of social, political, economic, and ethical issues influencing effective practice of adult education. Participant formulation and analysis of problems, issues, and challenges relevant to their practice and advanced graduate study.

Prerequisite: 15 Semester hours of graduate credit in the Department of Adult and Community College Education, including 3 semester hours of either quantative or qualitative research methods.
Typically offered in Spring only

EAC 767 Education Of Special Adult Populations (3 credit hours)
Analysis and development of adult education responses to needs and characteristics of special adult populations such as nonliterate, unemployed, handicapped and older adults.

Typically offered in Spring and Summer

EAC 778 Law and Higher Education (3 credit hours)
Constitutional, statutory and case law in relationship to higher education. Emphasis on faculty, student and staff rights and tort liability.

Prerequisite: Six hrs. graduate credit
Typically offered in Fall only

EAC 779 Concepts and Principles Of Evaluation Applied To Non-Formal Adult Education Prog (3 credit hours)
Introduction to evaluation of non-formal adult educational programs; course topics include purposes of evaluation, alternative concepts and techniques, stake holders and their concerns, specification of evidence, selection of standards for making judgments, gathering and analysis of data, use and dissemination of results and handling problems in evaluation.

Prerequisite: EAC 703
Typically offered in Spring only

EAC 786/EMS 786 Teaching in College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures andother types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Fall only

EAC 787 Organizational Theories and Concepts in Higher Education (3 credit hours)
For present and potential administrators interested in increasing their understanding of organizational theories as a basis for administration of effective higher education programs.

Typically offered in Fall and Spring

EAC 788 Applied Qualitative Data Analysis (3 credit hours)
Intermediate graduate level course in applied qualitative methodology following an introductory course in qualitative methods. Focuses on analytical approaches and tools used with qualitative data, with particular emphasis on adult and higher education and human resource development.

Prerequisite: EAC 785

EAC 790 Advanced Qualitative Research Methods (3-6 credit hours)
Advanced guidance for students designing or preparing for qualitative study. Emphasis on developing deeper understanding of theoretical issues informing qualitative research, including assessing validity of data and justifying design. Student development of a research proposal.

Prerequisite: EAC 785
Typically offered in Fall only

EAC 795 Topical Problems in Adult and Community College Education (1-3 credit hours)

EAC 802 Seminar In Adult and Higher Education (1-3 credit hours)
Identification and scientific analysis of major issues and problems relevant to adult education or higher education. Course credit at the doctoral level through active student participation in a formal seminar and scientific appraisal and solution of a selected problem. Student acquisition of a broad perspective of issues confronting adult educators and experiences in scientific analysis and solution of specific issues.

Prerequisite: Graduate standing
Typically offered in Fall only

EAC 803 Research Seminar in Adult and Higher Education (3-6 credit hours)
Examination and application of frameworks, processes and compositional approaches in developing research proposals focusing on problems in adult education and higher education.

Prerequisite: 6 semester hours of course work in research methodology/ analysis
Typically offered in Spring only

EAC 824 Topical Problems In Adult and Higher Education (1-3 credit hours)
Study and scientific analysis of problems in adult and higher education at the doctoral level and preparation of a scholarly research paper or project. Credits Arranged.

Prerequisite: Graduate standing or PBS status

EAC 830 Independent Study in Adult and Higher Education (3 credit hours)
Independent study for doctoral students in Adult and Higher Education.

Typically offered in Fall, Spring, and Summer

EAC 851 Internship In Adult and Higher Education (1-9 credit hours)
Utilization of the participant-observer role with required participation in selected educational situations. Emphasis upon observational skills development, the recording of relevant observations through written journals, analysis of experiences identifying critical incidents and projection of events and consequences. Student development and selection of possible alternative courses of action in various situations and evaluation of the consequences of the selected course of action.

Prerequisite: Nine hrs. in graduate level courses
Typically offered in Fall, Spring, and Summer

EAC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EAC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EAC 892 Doctoral Research Project (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Choice of research on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: EAC 732
Typically offered in Fall and Spring

EAC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EAC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EAC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

EAC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Advanced Analytics (AA)

AA 500 Analytics Tools and Techniques (3 credit hours)
This course equips the student with basic and advanced computer programming skills needed to use industry-standard analytics tools for data analysis, including but not limited to: data access and management, data cleaning, data mining, text mining, geospatial analytics, forecasting, and optimization. Restricted to AA majors.

Corequisite: AA 501
Typically offered in Summer only

AA 501 Analytics Foundations (3 credit hours)
This course equips the student with basic knowledge of statistics required for further study in analytics. Topics include, but are not limited to: Exploratory Data Analysis, Linear Regression, Multiple Linear Regression, Regression Diagnostics, Logistic Regression, ANOVA, Cluster Analysis, Analysis of Tables, and Survey Data Analysis. Restricted to AA major.

Corequisite: AA 670
Typically offered in Summer only

AA 502 Analytics Methods and Applications I (6 credit hours)
This course equips the students with the methods and applications of advanced analytics. Topics include, but are not limited to: Time Series and Forecasting, Geospatial Data Analytics, Linear Algebra, Data Mining, Survival Data Analysis and Logistic Regression Models. Restricted to AA major.

Prerequisite: AA 501 and AA 670; Corequisite: AA 504
Typically offered in Fall only

AA 503 Analytics Methods and Applications II (6 credit hours)
This course equips the student with the methods and applications of advanced analytics. Topics include, but are not limited to: Advanced Data Mining, Text Mining, Financial Analytics, Risk Analytics, Marketing Science and Customer Analytics, Linear and Non-Linear Programming. Restricted to AA major.

Prerequisite: AA 502; Corequisite: AA 505
Typically offered in Spring only

AA 504 Analytics Practicum I (6 credit hours)
This course equips the student with the knowledge and skills needed to conduct and present large-scale studies based on advanced analytics. Student teams conduct analysis using large amounts of real-world data. Restricted to AA major.

Prerequisite: AA 501 and AA 670; Corequisite: AA 502
Typically offered in Fall only

AA 505 Analytics Practicum II (6 credit hours)
A continuation of AA 504, this course equips the student with the knowledge and skills needed to conduct and present large-scale studies based on advanced analytics. Student team conduct analysis using large amounts of real-world data. Restricted to AA majors.

Prerequisite: AA 504; Corequisite: AA 503
Typically offered in Spring only

AA 591 Special Topics in Advanced Analytics (1-6 credit hours)
Special Topics in Advanced Analytics

AA 691 Special Topics in Advanced Analytics (1-6 credit hours)
Special Topics in Advanced Analytics

Aerospace Studies (AS)

AS 121 Heritage and Values I (1 credit hours)
AS 121 is the first semester of a survey course designed to introduce students to the United States Air Force and provide an overview of the basic characteristics, missions, and organization of the Air Force. Companion Lab AS201 required for active cadets.

Typically offered in Fall only

AS 122 Heritage and Values II (1 credit hours)
AS 122 is the second semester of a survey course designed to introduce students to the United States Air Force and provides an overview of the basic characteristics, missions, and organization of the Air Force. Companion Lab AS201 required for active cadets.

Typically offered in Spring only

AS 201 Freshman and Sophomore Leadership Laboratory (1 credit hours)
AS 201 is the leadership lab component for freshman and sophmore cadets enrolled in the AFROTC program. This laboratory is the hands-on military training where you will apply the knowledge and theory from your academic classes.

Typically offered in Fall and Spring

AS 221 Team and Leadership Fundamentals I (1 credit hours)
Part I of a two-semester course laying the foundation for teams and leadership. The topics include skills that will allow students/cadets to improve their leadership on a personal level and within a team. The courses will prepare students/cadets for their field training experience where they will be able to put the concepts learned into practice. Companion Lab AS201 required for active cadets.

Typically offered in Fall only

AS 222 Team and Leadership Fundamentals II (1 credit hours)
Part II of a two-semester course laying the foundation for teams and leadership. The topics include skills that will allow students/cadets to improve their leadership on a personal level and within a team. The courses will prepare students/cadets for their field training experience where they will be able to put the concepts learned into practice. Companion Lab AS201 required for active cadets.

Typically offered in Spring only

AS 321 Leading People and Effective Communication I (3 credit hours)
AS321 is a three-credit hour elective and part I of a two-semester course that teaches students/cadets advanced skills and knowledge in management and leadership. Topics include leadership and management fundamentals, ethics training and communication skills. Students will gain a more in-depth understanding of how to effectively lead people, as well as, hone their writing and briefing skills. Companion Lab AS401 required for active cadets.

Typically offered in Fall only

AS 322 Leading People and Effective Communication II (3 credit hours)
Part II of a two-semester course that teaches students/cadets advanced skills and knowledge in management and leadership. Topics include leadership and management fundamentals, ethics training and communication skills. Students will gain a more in-depth understanding of how to effectively lead people, as well as, hone their writing and briefing skills. Companion Lab AS401 required for active cadets.

Typically offered in Spring only

AS 401 Junior and Senior Leadership Laboratory (1 credit hours)
AS 401 is the leadership lab component for junior and senior cadets enrolled in the AFROTC program. This laboratory is the hands-on military training where you will apply the knowledge and theory from your academic classes. Additionally it provides cadets an opportunity to practice their leadership as they train the underclassmen cadets.

Typically offered in Fall and Spring

AS 421 National Security Affairs/Preparation for Active Duty I (3 credit hours)
AS 421 is a three credit hour course and is designed for college seniors. It will give students the foundation to understand their role as military officers in American society. Course examines the factors affecting national security; analyzes the evolution and formulation of U.S. defense policy, strategy, and joint doctrine; and investigates the methods for managing conflict. Companion Lab AS401 required for active cadets.

Typically offered in Fall only

AS 422 National Security Affairs/Preparation for Active Duty II (3 credit hours)
AS 422 is a three credit hour course and is designed for college seniors. It will give students the foundation to understand their role as military officers in American society. Course examines the factors affecting national security; analyzes the evolution and formulation of U.S. defense policy, strategy, and joint doctrine; and investigates the methods for managing conflict. This final semester provides information that will prepare the cadets for Active Duty. Companion Lab AS401 required for active cadets.

Typically offered in Spring only

AS 495 Special Topics in Aerospace Studies (2 credit hours)
Offered as needed to treat new or special subject matter relating to the Department of the Air Force.

Typically offered in Fall and Spring

Africana Studies (AFS)

AFS 230/MUS 230 Introduction to African-American Music (3 credit hours)
Comprehensive survey of African-American music in the United States from Colonial times to the present, with emphasis on its unique features and contributions to American culture.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall only

AFS 240 African Civilization (3 credit hours)
An interdisciplinary study of centers of African civilization from antiquity to the 1960s. Such centers include ancient Egypt, Nubia, Axum, Ghana, Mali, Songhai, Kilwa, Malinda, Sofola, Zinzibar and Monomotapa.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

AFS 241 Introduction to African American Studies (3 credit hours)
Introduces students to the field of African American/Black Studies. A transdisciplinary approach is used that includes humanistic and social scientific disciplines. The course offers an intellectual and methodological framework for understanding the past, present, and future of people of African descent in the United States of America. Topical areas are covered that capture the historical, political, economic, cultural, sociological and psychological experiences of African Americans.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

AFS 248/ENG 248 Survey of African-American Literature (3 credit hours)
African-American writing and its relationships to American culture and history. Covers such writers as Wheatley, Douglass, Chesnutt, Dunbar, DuBois, Hughes, Hurston, Wright, and Morrison.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

AFS 260/MUS 260 History of Jazz (3 credit hours)
History of jazz and the contributions of major artists. Emphasis of the various styles that have contributed to this American art form. Investigation of structural forms in the jazz idiom.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring and Summer

AFS 275/HI 275 Introduction to History of South and East Africa (3 credit hours)
The African kingdoms (Lunda, Buganda, and Zulu); the European encroachment; the origins of colonialism and the character of colonial societies and economies, South African apartheid; African protest, nationalism and independence.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

AFS 276/HI 276 Introduction to History of West Africa (3 credit hours)
The history of Western Africa. Forest civilizations and the slave trade, trade and the expansion of Islam, colonialism in West Africa; African nationalism and the achievement of independence; and postcolonial West Africa.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

AFS 305/SOC 305 Racial and Ethnic Relations (3 credit hours)
Study of the nature of the relationships among racial and ethnic groups in societies around the world but with emphasis on the United States. Explores topics such as inequalities of wealth, power, and status, racism, conflict, and social boundaries among groups. Current trends in intergroup relations are discussed.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

AFS 342 Introduction to the African Diaspora (3 credit hours)
Exploration of the global experiences of people of African descent. Geographical areas include the Americas, Europe, Asia, and the Caribbean. Exploration of the web of interrelated histories, social dynamics, and politico-economic processes affecting and reflecting world cultures and histories. Foundational course for the exploration of methodological issues and theoretical concerns in the field of African Diaspora Studies.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

AFS 343/REL 343 African American Religions (3 credit hours)
History of religions among Americans of African descent from the period of the development of the transatlantic slave trade to the present. Exploration of the complex ways religion has shaped the lifeworld of African Americans.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

AFS 344 Leadership in African American Communities (3 credit hours)
Historical, cultural and political examination of the dynamics of leadership in African American communities. Focus on structure of Leadership in the context of gender, ideology, and style. Interdisciplinary examination of impact of leaders on broader American society.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

AFS 345/PSY 345 Psychology and the African American Experience (3 credit hours)
Historical and cultural examination of the psychological experiences of African American experience from pre-American times to the present. Focus on mental health, personality, identity development, racism, oppression, psychological empowerment andan African-centered world view. Discussion of contemporary issues within the African American community.

Prerequisite: PSY 200 or PSY 201
GEP U.S. Diversity
Typically offered in Fall and Spring

AFS 346/ARS 346 Black Popular Culture (3 credit hours)
A multidisciplinary examination of contemporary black cultural expression in film, music, art, and the media. Emphasis on race, class, gender, and political discourse. This class may be scheduled with a small percentage of seats held for IDS Students Only.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

AFS 349/ENG 349 African Literature in English (3 credit hours)
Anglophone literature in Africa. Emphasis on the relationship between the African world-view and literary production and the persistent trend by African writers to connect literature with politics. Writers such as Achebe, Ngugi, Soyinka, and Serote.

Prerequisite: Sophomore standing and above
Typically offered in Spring only

AFS 372/HI 372 African-American History Through the Civil War, 1619-1865 (3 credit hours)
African background and continuity of the particular role, experience and influence of African Americans in the United States through the Civil War.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 373/HI 373 African-American History Since 1865 (3 credit hours)
The history of African-Americans from the Reconstruction era through the Civil Rights movement of the 1950s and 1960s to the present.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

AFS 375/ENG 375 African American Cinema (3 credit hours)
Survey and analysis of African American film culture from 1900-present. Examination of pre-Hollywood, classical Hollywood, and Independent filmmaking. Particular focus on independent filmmakers' response to dominant industry representations and the work of filmmakers who seek to create a specifically African American cinematic style.

P: ENG 101
GEP U.S. Diversity
Typically offered in Fall and Spring

AFS 380/WGS 380 Black Feminist Theory (3 credit hours)
Focused examination of Black feminist theory as a significant and distinct body of work. Interdisciplinary exploration of the impact of Black feminist theory on movements for social justice, the development of academic feminism generally, and the lived experience of Black women both in the United States and internationally.

Prerequisite: Any 200-level course in either WGS or AFS
GEP U.S. Diversity
Typically offered in Fall and Spring

AFS 409/PS 409 Black Political Participation in America (3 credit hours)
African American political participation in the United States; political culture, socialization, and mobilization, with a focus on the interaction between African Americans and actors, institutions, processes, and policies of the American political system.

Typically offered in Fall only

AFS 440 Senior Seminar in Africana Studies (3 credit hours)
In-depth examination of Africana Studies issues. Interdisciplinary exploration of key problems and proposed solutions for African communities on the African continent and throughout the world. Requires written research project using interdisciplinary approaches and critical analyses.

Prerequisite: AFS 342; Africana Studies Majors or Africana Studies Minors
Typically offered in Spring only

AFS 442 Issues in the African Diaspora (3 credit hours)
Multidisciplinary exploration of the interrelated histories, social dynamics, and politico-economic processes of the experiences of people of African descent throughout the world. Particular focus on the experiences of slavery, artistic expression, gender practices, and the impact of the nation-state.

GEP Humanities
Typically offered in Fall and Spring

AFS 448/ENG 548/AFS 548/ENG 448 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.

Requirement: Junior Standing
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

AFS 455/HI 555/AFS 555/HI 455 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 470 The Red Record and The Birth of a Nation (3 credit hours)
This course addresses the power of mass media and the tactics used by early black journalists to confront and subvert racist propaganda. Featured in this course are Ida B. Wells and her efforts in the late 19th and early 20th century to identify and call out justification for the lynching of Black people, especially Black men. We look at Wells' efforts, and what informed them, in juxtaposition with the film Birth of a Nation by director D. W. Griffith. The goal is for students to understand the enduring significance of the film as a piece of propaganda, and the foundation for the manner in which Hollywood situates and engages with the Black character.

GEP Humanities
Typically offered in Fall only

AFS 475/HI 575/AFS 575/HI 475 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa's society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

AFS 476/HI 576/AFS 576/HI 476 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of history
GEP Global Knowledge

AFS 479/HI 579/AFS 579/HI 479 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

AFS 490 Africana Studies and Community Involvement (3 credit hours)
First part of a two semester service-learning experience. Provides interdisciplinary and experientially based opportunity for students to engage in community and classroom-based experiences that examine issues of relevance to African American people(or communities in the African Diaspora). Students apply and examine concepts addressed in class to their own practical experience in service to others. Development of interpersonal and professional skills. Focus on the values, beliefs, attitudes, and ideas that are central to definitions of democracy, social justice, civic resiliency, self-help, and public life.

Prerequisite: Africana Studies Majors or Africana Studies Minors
Typically offered in Fall only

AFS 491 Study Abroad in Africana Studies (3 credit hours)
Specific category of revolving set of field/seminar courses involving multidisciplinary focal areas taught in foreign countries through Africana Studies. Course includes pre-trip orientation and readings and onsite field experiences and lectures. Additional program fees, travel costs and appropriate immunizations are required beyond registration fees.

Typically offered in Summer only

AFS 497 Topics in African-American Studies (3 credit hours)
Multidisciplinary examination of selected topics in African-American studies.

Prerequisite: AFS 240
Typically offered in Fall and Spring

AFS 548/ENG 448/AFS 448/ENG 548 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.

Requirement: Junior Standing
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

AFS 555/HI 455/AFS 455/HI 555 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

AFS 575/HI 475/AFS 475/HI 575 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa's society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

AFS 576/HI 476/AFS 476/HI 576 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of history
GEP Global Knowledge

AFS 579/HI 479/AFS 479/HI 579 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

Agricultural and Extension Education (AEE)

AEE 101 Introduction to Career and Technical Education (1 credit hours)
Overview of career and technical education programs, objectives, and outcomes in secondary schools. Philosophy of career and technical education and how career and technical education programs fit into the overall mission of secondary education. Mission of agricultural education, major program objectives, and introduction to the curricula taught within the state. Roles and responsibilities of CTE teachers with specific emphasis on agricultural education teachers' roles and responsibilities.Historical context of agricultural education and other career and technical education programs, including major legislation affecting development of career and technical education.

Typically offered in Fall only

AEE 103 Fundamentals of Agricultural and Extension Education (1 credit hours)
Introduction to the scope, purpose, and objectives of university education with an emphasis on agricultural education, extension education, and agricultural communications. Students will explore College and departmental resources, academic policiesand procedures, the agricultural industry, career opportunities, and current trends and issues in agriculture. Cannot receive credit for both AEE 103 and ALS 103

Typically offered in Fall only

AEE 141 Computer Applications in the Agricultural Institute (2 credit hours)
Introduction to computing concepts and the computing infrastructure in the Agricultural Institute. Use of computing hardware and software to perform common tasks, explore networked computer resources and solve problems associated with the various curricula in the Agricultural Institute. BOSTICK

Typically offered in Spring only

AEE 206 Introduction to Teaching Agriculture (3 credit hours)
Introduction to teaching agricultural education in middle and secondary schools and collaborative efforts for teaching agricultural education to adults as rural community situations dictate. Field experiences include three hours per week of structured observations of classroom teachers, teacher assistant activities, and reflections of the experience.

Typically offered in Fall only

AEE 208/ANS 208/PB 208 Agricultural Biotechnology: Issues and Implications (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183)
GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

AEE 226 Computer Applications and Information Technology in Agricultural & Extension Ed (3 credit hours)
Use of computers and commercially produced agricultural software; the computer as a management tool; agricultural occupational applications of the computer; a multimedia instructional tool in agricultural classrooms and training situations; use of technology for processing information and imaging; network access; and electronic communications.

Typically offered in Fall and Spring

AEE 230 Introduction to Cooperative Extension (3 credit hours)
This course is designed for all students who are interested pursuing a career with the cooperative extension service. An introduction to the cooperative extension mission, philosophy, history, organization,structure, administration, program areas, extension program development, extension teaching and delivery methods, and the involvement and use of volunteers. Students are expected to provide their own transportation for outside of class activities and assignments.

Typically offered in Fall only

AEE 303 Administration and Supervision of Student Organizations (3 credit hours)
Principles and techniques for organizing, administering and supervising student organization activities.

Prerequisite: AEE 206
Typically offered in Spring only

AEE 311 Communication Methods and Media (3 credit hours)
Foundations of agricultural communications. Technologies of agricultural communication and the systematic approach to the development of agricultural communication materials. Development of applied skills in design, production, evaluation, and dissemination of information unique to agricultural sciences and media.

Prerequisite: ENG 101
Typically offered in Fall and Spring

AEE 322 Experiential Learning in Agriculture (3 credit hours)
Planning, organizing, implementing, supervising and evaluating Supervised Agricultural Experience (SAE) programs in agriculture.

Prerequisite: AEE 206
Typically offered in Fall only

AEE 323 Leadership Development in Agriculture and Life Sciences (3 credit hours)
AEE 323 is designed to introduce you to the awesome complexity of leadership. Leadership educators believe that leadership can be learned. In this course, we study leadership theory to help us understand our leadership potential, the potential of others, and the impact great leadership can have on people, organizations, and society. We separate skills you gain from going out and doing leadership (the do) from theories that provide foundations for leadership (the think). Effective leadership is important in all contexts, including food and agriculture. We believe it is ESSENTIAL that effective leaders both THINK and DO!

GEP Social Sciences
Typically offered in Fall and Spring

AEE 325 Planning and Delivering Non-Formal Education (3 credit hours)
Adult learning theory and practice, including planning non-formal educational programs for adults, methods of instructional delivery, effective use of instructional technology, marketing educational programs, and evaluation of educational outcomes.Microteaching (practice teaching presentations) and group presentations required as part of laboratory assignments.

Typically offered in Fall only

AEE 326 Teaching Diverse Learners in AED (3 credit hours)
Legislation and issues regarding diverse learners in middle and high school agricultural education are examined. Discussion and practice in planning and facilitating teaching strategies to help those with special needs in an agricultural setting are emphasized. Techniques to integrate reading and writing into the curriculum are identified and practiced. Field trips are required.

Prerequisite: AEE 206; Junior standing; and AED Majors only
Typically offered in Spring only

AEE 327 Conducting Summer Programs in Agricultural Education (1 credit hours)
Field experience emphasizing summer agricultural education programs. Individualized instruction for students during supervised agricultural experience visits and youth organization activities. Professional development and program improvement activities.

Prerequisite: AEE 206, AEE 303, AEE 322, and Corequisite of AEE 426
Typically offered in Fall only

AEE 350 Personal Leadership Development in Agriculture and Life Sciences (3 credit hours)
This course focuses on the development of each student's capacity to lead in ways that reflect their values and to address big, messy challenges through leadership. Students will examine human behavior through the lenses of authentic and adaptive leadership and work to develop their own capacity for authentic and adaptive leadership. They will apply critical and creative thinking processes to analyze adaptive challenges and develop potential solutions in the realms of agriculture, food, and natural resources.

GEP Social Sciences
Typically offered in Spring only

AEE 360 Developing Team Leadership in Agriculture and Life Sciences (3 credit hours)
Students in this course will study the impact of organized teams and team leaders on the development of agricultural organizations. Principles and techniques involved in creating, organizing and directing teams will be explored. Students will develop skills in team decision-making and communication. Topics of discussion will include: components of a group and team, relationships of group and team members, effectiveness of groups and teams, and communication within groups and teams. This course is designed for students who are interested in positions of leadership and who want to learn more about making the groups and teams they work with more effective.

Prerequisite: AEE 323-Leadership Development in Agriculture
Typically offered in Fall only

AEE 423 Practicum in Agricultural Extension/Industry (8 credit hours)
Participation in professional work experiences in preparation for effective leadership positions in the Cooperative Extension Service or the agribusiness industry.

Prerequisite: AEE 230, AEE 325, and Corequisite of AEE 490
Typically offered in Spring and Summer

AEE 424 Planning Agricultural Educational Programs (3 credit hours)
Principles of program planning applied to educational programs in agriculture; includes theory and field experiences in planning, organizing, and evaluating high school and adult education programs.

Prerequisite: AEE(ED) 426, Corequisite: AEE(ED) 427
Typically offered in Spring only

AEE 426 Methods of Teaching Agriculture (3 credit hours)
Discussion and practice in planning and presenting instruction in agriculture in formal and informal settings. Principles and application of approaches to teaching and organizing instruction, motivating students, developing instructional objectives, selecting and using teaching techniques, evaluating instruction, and managing classroom and laboratory instruction.

Prerequisite: Junior standing.
Typically offered in Fall only

AEE 427 Student Teaching in Agriculture (8 credit hours)
Skills and techniques involved in teaching vocational agriculture through practice in a public school setting with concurrent on-campus seminars.

Prerequisite: AEE (ED) 426; Admission to Professional Semester, Corequisite: AEE (ED) 490, AEE (ED) 424;
Typically offered in Spring only

AEE 433/AEE 533 Leadership and Management of Volunteers in Agricultural and Extension Education (3 credit hours)
This course is intended to prepare students to be effective managers of volunteer programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major topics of the course will include, but are not limited to: volunteer recruitment, training, evaluation and reward. Students will be required to be active in and outside of class sessions, including a 20-hour field experience. Students must provide their own transportation for field trips and outside of class activities. Cannot receive credit for both AEE 433 and 533.

Prerequisite: Junior standing
Typically offered in Fall only

AEE 435 Professional Presentations in Agricultural Organizations (3 credit hours)
This course teaches effective listening strategies, communication strategies, interpersonal skills and presentation strategies essential for use in today's workplace. AEE 435 includes strategies and techniques for effective presentations in the food, agricultural, natural resources, as well as other professions, with emphasis on oral and visual presentation techniques. Presentation skills and strategies for formal and informal situations including conferences, poster presentations along with leadership, conflict resolution, interviewing, negotiation, and group communication theory and strategies will be discussed. Restricted to CALS students; Jr or Sr level status required.

Typically offered in Fall and Spring

AEE 460 Organizational Leadership Development in Agriculture and Life Sciences (3 credit hours)
This course focuses on the impact of effective leadership in organizations in both theory and practice. Students will examine the major theories and studies that are most relevant and informative with the regard to leadership in organizations. Students will develop skills in decision-making, management of organizations, and ethical leadership related to agricultural organizations.

Prerequisite: AEE 323-Leadership Development in Agriculture
Typically offered in Spring only

AEE 478 Advanced Issues in Extension Education (3 credit hours)
Advanced issues and trends contributing to the administration, organization, and structure of extension education in a changing world. Senior standing required.

Prerequisite: AEE 230
Typically offered in Spring only

AEE 490 Seminar in Agricultural and Extension Education (3 credit hours)
Capstone experience in Leadership in Agricultural and Life Sciences for Agricultural Sciences majors. Students will apply theories and concepts from their leadership courses to a planned leadership experience. Reflection on and documentation of intentional leadership experiences will lead to a final presentation in the course of leadership lessons learned and areas for continued development.

Prerequisite: Senior Standing and students in 11AGSBS and 11EXTEDBS
Typically offered in Spring only

AEE 491 Seminar in Agricultural Education (1 credit hours)
This course helps students analyze the opportunities and challenges facing teachers of agriculture as they prepare for their careers. Topics include balancing work and professional life as a teacher, portfolio assessments of teachers and programs, classroom management, teacher liability, and preparation for the job search in agricultural education.

Corequisites: AEE 424 and AEE 427
Typically offered in Spring only

AEE 492 External Learning Experience in Agricultural and Extension Education (1-6 credit hours)
Learning experience within an academic framework that utilizes facilities and resources external to the campus. Contact and arrangements with prospective employers initiated by the student and approved by the faculty adviser, prospective employer, and the departmental teaching coordinator prior to the experience. Not intended for teaching licensure for students in AEE

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

AEE 493 Special Problems in Agriculture and Extension Education (1-6 credit hours)
A learning experience in agriculture and extension education within an academic framework that utilizes departmental campus facilities and resources. Arrangements must be initiated by the student and approved by a faculty adviser and the departmental teaching coordinator. Not intended for teacher licensure for students in AEE.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

AEE 495 Special Topics in Agricultural and Extension Education (1-3 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offerings of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

AEE 501 Foundations Of Agricultural and Extension Education (3 credit hours)
Development and organization of agricultural and extension education in America from colonial times to the present. Emphasis on role of societal and scientific changes, the federal government and philosophy on evolution of agricultural and extension education.

Typically offered in Fall and Summer

AEE 503 Youth Program Management (3 credit hours)
Research, theory and principles of youth organization management. Analysis of youth development models and application of leadership theory in a youth organization. Using evaluation models to assess the effectiveness of major youth organization. Web-based course.

Typically offered in Spring only

AEE 505 Trends and Issues in Agricultural and Extension Education (3 credit hours)
Trends and Issues in Agricultural and Extension Education. Analysis and appraisal of current trends, problems and issues in Agricultural and Extension Education. May include but not limited to scientific, political, demographic, social, educational, technological, and environmental trends and issues that will contribute to the future structure and operation of agricultural and extension education in the United States.

Typically offered in Spring only

AEE 507 Comparative Agricultural and Extension Education (3 credit hours)
Organization and operation of formal and nonformal agricultural education and extension systems in the United States and in other countries. Field trip required - cost approx. $175.00.

Typically offered in Fall only

AEE 521 Program Planning in Agricultural and Extension Education (3 credit hours)
Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

AEE 523 Adult Education in Agriculture (3 credit hours)
Designed to meet needs of leaders in adult education. Opportunity to study issues in working with adult groups. Attention given to the problem of fitting educational program for adults into public school and other educational programs and to methods of teaching adults.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

AEE 524 Coordinating the High School Agricultural Education Program (3 credit hours)
Principles of program planning applied to educational programs about agriculture; theory and field experiences in planning, organizing, and evaluating secondary agricultural education programs; development of plans for conducting all aspects of the complete agricultural education programs.

Typically offered in Spring only

AEE 526 Information Technologies in Agricultural and Extension Education (3 credit hours)
Principles, theory and techniques of using information technologies to provide instruction to learners, both in person and at a distance, in formal and non formal educational settings.

Typically offered in Spring only

AEE 533/AEE 433 Leadership and Management of Volunteers in Agricultural and Extension Education (3 credit hours)
This course is intended to prepare students to be effective managers of volunteer programs. Theory will be emphasized in the course because it is essential to be grounded in theory in order to apply it. Major topics of the course will include, but are not limited to: volunteer recruitment, training, evaluation and reward. Students will be required to be active in and outside of class sessions, including a 20-hour field experience. Students must provide their own transportation for field trips and outside of class activities. Cannot receive credit for both AEE 433 and 533.

Prerequisite: Junior standing
Typically offered in Fall and Spring

AEE 535 Teaching Agriculture in Secondary Schools (3 credit hours)
Application of theoretical models and research on effective teaching in secondary agricultural education programs. teaching strategies, planning required, and instructional management for students with varying backgrounds. Evaluation of student learning and teacher evaluation of instruction.

Typically offered in Fall only

AEE 577 Evaluation in Agricultural and Extension Education (3 credit hours)
Evaluation is an important part of many social science disciplines and grant projects. The intent of this course is to teach students how to plan and conduct a meaningful and useful evaluation. Students will gain knowledge and skills in planning evaluations; designing evaluation studies and evaluation instruments; collecting and analyzing data; and using evaluation results. Students will learn evaluation theoretical concepts and their application in real-life situations.

Restriction: Graduate Standing or PBS
Typically offered in Spring only

AEE 579 Research Design in Agricultural and Extension Education (3 credit hours)
Design of Research in Agricultural and Extension education. Development of proposals for thesis research or competitive grants. Critical analyses of research in the field and proposed research.

Typically offered in Fall only

AEE 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

AEE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

AEE 705 International Agricultural Development (3 credit hours)
This course provides an opportunity to learn about global agricultural and extension education issues, challenges and opportunities relating to agricultural development. The course emphasis is on building necessary knowledge and skills for analyzing global agricultural and extension education issues and formulating alternatives for agricultural development. This course has been designed to help graduate students understand agriculture and extension education with a global perspective.

Prerequisite: Graduate standing
Typically offered in Fall only

AEE 820 Special Problems in Agricultural and Extension Education (1-6 credit hours)
Exploration of topics of special interest not covered by existing courses by individual students under faculty member's directions. Readings and independent study, problems or research not related to a thesis.

Typically offered in Fall, Spring, and Summer

AEE 841 Practicum in Agricultural and Extension Education (1-6 credit hours)
Faculty-supervised practicum in an educational, extension or agricultural industry setting.

Typically offered in Fall, Spring, and Summer

AEE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

AEE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

AEE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

AEE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

AEE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Agricultural Economics (ARE)

ARE 104 Agricultural Business Management (3 credit hours)
Insights into the management skills of a successful agribusiness firm manager. A topical approach to analytical and planning techniques applicable to business decisions. Managerial concepts such as financial analysis, budgeting, investment analysis, capital acquisition, financial and risk management of agribusiness firms. HENDRICKSON

Typically offered in Fall, Spring, and Summer

ARE 106 Agri Business Law (3 credit hours)
The application of legal principles to agribusiness. Includes a review of our legal system contracts, real property, personal property torts, business organization, estate planning, and laws affecting agribusiness.

Typically offered in Fall and Spring

ARE 112 Agricultural & Agribusiness Marketing (3 credit hours)
Marketing concepts, techniques and management of the U.S. marketing system from agricultural production, agribusiness, and traditional business perspectives. Broad, basic knowledge of marketing objectives, the marketing environment, strategic planning, marketing information sources, consumer demographics and lifestyle characteristics, product planning, distribution planning, promotion planning, and price planning. PHILLIPS

Typically offered in Fall only

ARE 113 Principles of Salesmanship (3 credit hours)
How To" course in selling. Understanding customer's behavior, establishing and maintaining customer rapport, and negotiating a sale. Developing sales skills through discussion, role playing and demonstrations. Emphasis on building self-confidence through selling exercises involving class participation, special assignments, and targeted presentations. WEEMS

Typically offered in Fall and Spring

ARE 114 Value Added Agriculture and Niche Marketing (3 credit hours)
Value Added Agriculture and Niche Marketing are ways to increase farm revenue without having to go off farm for employment. This course is designed to provide insights into the opportunities that are available to increase farm revenue, to see what other farms are currently doing with value added within the region, and to create a value added business plan for expanding farm offerings. Site visits are required components of this course. University transportation provided to all site visits. Student transportation (estimated at $30 per student and site visit (estimated at $7 each for 2 sites) fees apply.

Typically offered in Fall only

ARE 115 Agribusiness Accounting (3 credit hours)
Introduction to basic accounting principles and concepts applicable to an agribusiness firm. Exposure to journals, ledgers and financial statements. Topics of the accounting cycle, inventories, payrolls, accounts receivable, income taxes and the potential use of computers. RUSS

Typically offered in Fall, Spring, and Summer

ARE 121 Agricultural Finance (3 credit hours)
Agricultural Finance teaches students introductory concepts for financial management decisions in agricultural/farm businesses. Topics include building a financial control process, developing risk management strategies, and analyzing investment opportunities. Emphasis is on developing skills necessary to create a financial business plan.

Restriction: AGI Only
Typically offered in Fall, Spring, and Summer

ARE 132 Management of Personnel (3 credit hours)
Personnel problems of recruiting, selecting, training, paying, and motivating employees of an agribusiness firm. Improving organizational effectiveness, functioning of a production supervisor, resolution of conflicts and leadership development. PHILLIPS

Typically offered in Fall and Spring

ARE 133 Agricultural & Environmental Policy (3 credit hours)
History of agricultural and environmental policy, policy formation, agricultural programs, effects of agricultural production on the environment, benefits and costs of agricultural and environmental policy, state of the environment, environmental regulations and their enforcement, optimal level of pollution, incentive-based environmental regulation, outlook for agricultural and environmental policy, and the sustainability of agriculture and of the environment. RUSS

Typically offered in Fall, Spring, and Summer

ARE 141 Personal Financial Management (3 credit hours)
Economic analysis of personal decisions related to consumer purchases, time value of money, taxes, financial risk management, investment strategies, retirement planning and estate planning. Relationship of an individual's life cycle to budgeting and financial goals. Background information on wise use of credit, home purchase, life insurance, property insurance, health insurance and investment fundamentals. PHILLIPS

Typically offered in Spring only

ARE 194 International Agribusiness Management Study Abroad (1-6 credit hours)
This course is designed to maximize student potential for success by developing a globally and multi-culturally competent agricultural and agribusiness workforce. This course addresses these issues by providing opportunities for students to study abroad in various locations around the world, with different destinations offered each academic year. Credit hours are variable based on length or travel and classroom instruction pre- and post-travel consistent with NCSU policies and practices. Course may be repeated for credit to visit different destinations only. Significant expenses for travel are involved. Please see the instructor for specific program details.

Typically offered in Spring and Summer

ARE 201/ARE 201A Introduction to Agricultural & Resource Economics (3 credit hours)
Introduction to economic principles of marginal benefits and costs with application to consumer and producer decisions. Functions of market exchange systems in determining prices and quantities and creation of wealth. Property rights and opportunities for exchange. Role of government in dealing with agricultural and resource problems. Macroeconomic analysis including inflation, unemployment, money and banking system. Credit will not be given for both ARE 201 and either EC 201 or EC 205.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ARE 201A/ARE 201 Introduction to Agricultural & Resource Economics (3 credit hours)
Introduction to economic principles of marginal benefits and costs with application to consumer and producer decisions. Functions of market exchange systems in determining prices and quantities and creation of wealth. Property rights and opportunities for exchange. Role of government in dealing with agricultural and resource problems. Macroeconomic analysis including inflation, unemployment, money and banking system. Credit will not be given for both ARE 201 and either EC 201 or EC 205.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ARE 215 Small Business Accounting (3 credit hours)
Record keeping for small businesses organized as sole proprietorships, partnerships, and family held corporations. Double entry accounting principals applied to service and merchandising businesses. General Journals, Combination Journals, Subsidiary Journals, Ledgers, Accounts Receivable, Accounts Payable, Posting, Worksheets. Financial Statements, Closing, Payrolls, Cost Basis, Depreciation, Section 179, Amortization, Financial Adjustments, and Income Tax Forms. Both manual and computerized systems. Semester project of keeping records for a business for a portion of the year.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 260 Marketing and Risk Management in the Pork Industry (1 credit hours)
A comprehensive overview of structure and trends in markets and marketing options available in the swine industry. Management of market risk with hedging or other contracts.

Prerequisite: ANS 150
Typically offered in Spring only

ARE 270 Principles of Agribusiness Entrepreneurship (3 credit hours)
Principles of Agribusiness Entrepreneurship is the first course of three in the Agribusiness Entrepreneurship course sequence. It teaches students the applied entrepreneurship skills needed to identify and create an opportunity in agribusiness and how to develop a business canvas model and conduct a feasibility analysis for a real business idea. Students attend class at the NC State E-Clinic in HQ Raleigh for four classes and transportation is included.

Corequisite: ARE 201
Typically offered in Fall and Spring

ARE 290 Professional Development in Agricultural Business Management (3 credit hours)
This course focuses on establishing professional development foundations for incoming students in Agricultural Business Management. The material emphasizes on diversity in the field and workplace, career exploration, and preparation for internship and work applications. Topics include self-reflection, goal-setting, professional development, resume building, job shadowing, and identity exploration from local, global, and workplace perspectives. Non-scheduled class time for field trips or out-of-class activities are required one day per semester for this class. If transportation will pose a problem for a student, the department will provide transportation. This course is restricted to students in the Agricultural Business Management major or admission by departmental approval.

Restriction: Agricultural Business Management major or departmental approval.
Typically offered in Fall, Spring, and Summer

ARE 295 Special Topics in Agricultural & Resource Economics (200 Level) (1-6 credit hours)
An offering of new freshman to sophmore-level courses on trial basis with topics varying based on offerings. Repetition with different course content acceptable up to 4 times and for a total of 12 units.

Typically offered in Fall, Spring, and Summer

ARE 301/EC 301 Intermediate Microeconomics (3 credit hours)
Functioning of the market economy, role of prices in determining the allocation of resources, the functioning of the firm in the economy, forces governing the production and consumption of economic goods.

Prerequisite: MA 121 or MA 131 or MA 141 and EC 201 or EC 205 or ARE 201
Typically offered in Fall and Spring

ARE 303 Farm Management (3 credit hours)
Analytical and planning techniques for making business decisions centered around farm business applications. Economic principles and management concepts such as budgeting, accounting, finance credit, investment analysis, business organization, risk,and taxes as related to practical problems of operating a farm business.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall only

ARE 304 Agribusiness Management (3 credit hours)
Management decision-making by food, fiber, horticulture, and forestry firms. Emphasis on current agribusiness topics such as information utilization, strategic planning, organization structures, competitor intelligence, pricing, leadership, crisis management, ethics, and human resource management. Business communications, agribusiness case studies, and a computerized management simulation game.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 306 Agricultural Law (3 credit hours)
Legal principles of practical importance in an agricultural setting: the court system; tort, contract and real and personal property law; legal aspects of organizing an agribusiness; environmental and labor regulations affecting agriculture; income and estate taxation of agriculture. Credit for both ARE 306 and BUS 307 is not allowed

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 309 Environmental Law & Economic Policy (3 credit hours)
Current federal and state environmental laws and regulations and their common law foundations. Relationship of the law and its regulatory mechanisms to economic policy issues: externalities, pollution taxes, incentives, permit trading, and cost-benefit analysis. Major environmental topics including water and wetlands, solid and hazardous wastes, pesticides, clean air, endangered species and nuisance actions. Overview of the legal system.

Prerequisite: ARE 201 or EC 201 or EC 205
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ARE 311 Agricultural Markets (3 credit hours)
Agricultural marketing system and economic forces affecting its structure and efficiency. Public policy issues affecting agricultural markets. Emphasis on the analysis of current sources of agricultural market information. Marketing and storage problems over time; futures markets and the management of risk; transportation and international trade; government agricultural programs.

Prerequisite: ARE 201 or EC 201 or EC 205
GEP Social Sciences
Typically offered in Fall only

ARE 312 Agribusiness Marketing (3 credit hours)
Application of marketing and economic principles to decision making in contemporary agribusiness firms. Marketing strategies, marketing research and information, segmentation and targeting, marketing mix, and market plans within food, fiber, natural resource, and production input industries. Professional selling skills and knowledge. Off-campus field experience and visiting lecturers from the agribusiness industry.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 321 Agricultural Financial Management (3 credit hours)
Fundamental concepts for financial management decision in agricultural/farm businesses. Emphasis on financial statement analysis of profitability, efficiency, liquidity, repayment capacity, risk, leverage, growth. Capital budgeting, investment decisions, farmland bid price determination, farm real estate appraisal. Financial markets and credit institutions serving agriculture, lending policies, loan analysis, interest rate determination. Financial structure, performance, condition of farm sector.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Spring only

ARE 323 Agribusiness Finance (3 credit hours)
ARE 323 teaches the history of monetary systems, the development of business finance tools and banking, and detailed creation and use of business financial statements, including Income Statements, Balance Sheets, and Statements of Cash Flow, within the context of the agribusiness industry. Two Finance courses are offered in the Agribusiness Management Major: ARE 321 - Agricultural Financial Management, which focuses on the history of finance in agriculture and financial planning for farmers and similar independent agricultural enterprises; and ARE 323 - Agribusiness Finance, which focuses on finance for larger agribusinesses and for managers of agribusiness divisions in larger organizations.

Prerequisites: (ARE 201 or EC 201) and (ACC 200 or ACC 210 or equivalent Introductory Accounting Course)
Typically offered in Fall, Spring, and Summer

ARE 332 Human Resource Management for Agribusiness (3 credit hours)
General introduction to human resource management in agribusinesses. Skills for agribusiness owners for efficient productivity from employees in a legal and ethical manner. Topics on labor economics, human resource legislation, employee planning and recruitment, and migrant labor issues. Emphasis on techniques for training, motivating, leading, and disciplining employees.

Prerequisite: ARE 201 or EC 201 or EC 205
Typically offered in Fall, Spring, and Summer

ARE 336/EC 336 Introduction to Resource and Environmental Economics (3 credit hours)
Application of basic economic tools to understand and evaluate environmental/resource policies. Concepts such as property rights, non-market goods, allocation over time, externalities, and public goods. Current policy issues such as global climate change, evaluating natural resource damages from oil spills, reducing the costs of regulations, protecting estuaries, and dealing with non-point source pollution.

Prerequisite: ARE 201 or EC 201 or EC 205
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ARE 345 Global Agribusiness Management (3 credit hours)
Global trade is the largest growth area in American agribusiness, and knowledge of international agribusiness markets is one of the primary qualifications desired from college graduates entering the workforce. This course provides detailed knowledge of the six major regions for agribusiness trade worldwide, to prepare students to understand, speak intelligently about, and capitalize on opportunities for NC and US agribusiness products in the global marketplace. Students will be required to provide their own transportation to local markets and incidental expenses for meals representative of the six major regions connected with class assignments. Please see the Instructor for details.

Prerequisite: EC 201 or 205 or ARE 201
GEP Global Knowledge
Typically offered in Spring only

ARE 370 Agribusiness New Venture Development (3 credit hours)
Agribusiness New Venture Development is the second course of three in the Agribusiness Entrepreneurship course sequence. It teaches students how to develop a new venture idea into a business model. Students learn how to collect and interpret data needed to evaluate new businesses and to evaluate new ventures in existing businesses or institutions. Students develop actionable plans for start-up businesses or ventures. Student teams gain experience pitching their business models to prospective investors and partners. Students attend class at the NC State EClinic in HQ Raleigh for five classes and transportation is provided.

Prerequisite: ARE 270
Typically offered in Fall and Spring

ARE 395 Special Topics in Agricultural and Resource Economics (300 level) (1-6 credit hours)
An offering of new junior-level courses on trial basis with topics varying based on offerings. Repetition with different course content acceptable up to 4 times and total of 12 units.

Typically offered in Fall, Spring, and Summer

ARE 404 Advanced Agribusiness Management (3 credit hours)
An advanced course in business planning that integrates the risk and uncertainty associated with production, marketing, and financial management strategies of agribusiness firms. Focuses on the fundamental components required to develop a strategicbusiness plan and design a viable business strategy in the context of the firm's market and its internal environment. Special attention is given to the application of economic theory and analysis to business decision-making processes. 80% of enrollment is restricted to Agricultural & Resource Economics students with the remaining 20% open for all other majors.

Prerequisite: (ARE 303 or ARE 304), ARE 321, and (ARE 311 or ARE 312)

ARE 412 Advanced Agribusiness Marketing (3 credit hours)
ARE provides opportunities for undergraduates to gain experience with the practical application of Marketing principles with real and fictitious Agribusiness products through two courses taken on campus: ARE 412 and ARE 413. These opportunities are provided to students that are specifically interested in pursuing a Marketing or Sales position after graduation, especially when an internship is not an option. The practical applications often require two semesters (one full academic year) to complete, so student involved in projects are encouraged to take ARE 412 in the Fall and ARE 413 in the Spring. Projects very each year.

Prerequisite: ARE/EC 201 or EC 205; Pre- or Co-requisite: ARE 312 or BUS 360
Typically offered in Fall only

ARE 413 Applied Agribusiness Marketing (3 credit hours)
ARE provides opportunities for undergraduates to gain experience with the practical application of marketing principles with real and fictitious agribusiness products through two courses taken on campus, ARE 412 and ARE 413. These opportunities are provided to students that are specifically interested in pursuing a Marketing or Sales position after graduation, especially when an internship is not an option. The practical applications often require two semesters (one full academic year) to complete, so students involved in projects are encouraged to take ARE 412 in the Fall, and ARE 413 in the Spring. Projects vary each year. This course is an elective for ABM, BBM, and related CALS majors. Departmental approval required to enroll in course.

Prerequisite: ARE 201/EC 201 or EC 205, ARE 312, ARE 412
Typically offered in Spring only

ARE 415 Introduction to Commodity Futures Markets (3 credit hours)
An economic introduction to futures and options contracts and exchanges, with primary focus on agricultural and natural resource commodities.

Prerequisites: ARE 201 or EC 201 or EC 205 or equivalent
Typically offered in Spring only

ARE 420 Taxation in Agriculture, Production, and Agribusiness (3 credit hours)
Students will explore the effect of various tax obligations on farms and rural agribusinesses. Topics of discussion include income taxation, both federal and state, Social Security taxation, property taxation, sales and use taxation, and estate and gift taxation.

Prerequisites: ARE 215 or ARE 303 or ARE 304 or ARE 321
Typically offered in Spring only

ARE 425 Contracts and Organizations in Agriculture (3 credit hours)
This course deals with agricultural contracts and organizational structures in agriculture and food industries. The covered material relies on the economic theory to explain observed empirical phenomena. The approach also relies on the use case studies of different contractual arrangements observed in the U.S. agriculture. The content delivery consists of instructor's lectures, guest lectures and students' presentations. Grading is based on exams, presentations and a class project.

Prerequisite: ARE/EC 301 or equivalent or instructor's permission
Typically offered in Fall only

ARE 433 U.S. Agricultural Policy (3 credit hours)
Government economic policies and programs affecting agricultural inputs and farm products. Analysis of the rationale, objectives, and major types of agricultural programs and their effects on resource allocation and income distribution within agriculture and between agriculture and the rest of the economy.

Prerequisite: ARE(EC) 301
GEP Social Sciences
Typically offered in Fall and Spring

ARE 444 Ethics in Agribusiness (3 credit hours)
Ethical behavior is a crucial issue in American business, especially after numerous ethical lapses over the past decade, and for agribusiness given claims of marketing unhealthy foods, development of genetically-modified organisms, hiring of undocumented workers, and consolidation into industrial production facilities. Students are taught ethical theories and frameworks, used to discuss general ethical questions such as death, theft, and lying, followed by the more specific agribusiness issues mentioned above. Students will formulate their own opinions about these issues, recognize and understand the opinions of others, and be able to accurately and adequately communicate those opinions.

Typically offered in Fall and Spring

ARE 448 International Agricultural Trade (3 credit hours)
Study of the economic forces that drive international trade in agriculture, food, and natural resources. Economic principles, analytical techniques, and empirical analysis are used to explain international trade and foreign direct investment in the global marketplace.

Prerequisites: ARE 201 or EC 201 or EC 205 or equivalent.
Typically offered in Fall only

ARE 455 Agribusiness Analytics (3 credit hours)
Agribusiness Analytics provides and overview and involved application of analysis and common analytical methods in the agricultural industry. Emphasis on methods to predict, evaluate, and otherwise inform agribusiness decision makers.

Prerequisites: ST/BUS 350 or ST 311
Typically offered in Fall only

ARE 470 Agribusiness Entrepreneurship Clinical Skills Development (3 credit hours)
Agribusiness Entrepreneurship Clinical Skills Development is the third of three courses in the Agribusiness Entrepreneurship course sequence. This course teaches students the clinical skills needed to analyze questions faced by startups and other companies as they pursue opportunities in agribusiness. Students provide counseling to agribusiness developers in exchange for experience and an opportunity to build their business networks. Students will create and execute action plans with partner companies, conduct research, and develop a written analysis and recommendations for specific questions posed by the companies.

Prerequisite: ARE 270 and ARE 370
Typically offered in Fall and Spring

ARE 475 Food Policy (3 credit hours)
This course will provide students a theoretical basis and empirical tools to examine U.S. federal, state, and local food policies. Applications covered will explore contemporary food policy issues such nutrition assistance programs; regulations governing food safety, food transport and food trade; alternatives to the conventional food system (i.e. local foods, urban farming); health and nutritional labeling and claims; and the quickly evolving policy and legal environment affecting food adulteration, food fraud, and national food defense.

Prerequisites: ARE 301 or EC 301
Typically offered in Fall, Spring, and Summer

ARE 490 Career Seminar in Agriculture & Resource Economics (1 credit hours)
Planning and preparing for career choices. Resume writing, networking, interviewing, personality characteristics, and job searching. Visits with employer representatives. Employer expectations and career opportunities. Researching firms and employment opportunities. Oral and written presentations.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

ARE 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

ARE 493 Special Problems/Research Exploration (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ARE Sophomore standing
Typically offered in Fall, Spring, and Summer

ARE 494 Agribusiness Study Abroad (1-6 credit hours)
Global trade is the largest growth area in American agribusiness, and knowledge of international agribusiness markets is a primary qualification desired from college graduates entering the workforce. This course addresses these issues by providing opportunities for students to study abroad in various locations around the world, with different destinations offered each academic year. Credit hours are variable based on length of travel and classroom instruction pre-and post-travel consistent with NCSU policies and practices. Course may be repeated for credit to visit different destinations only. Significant expenses for travel are involved. Please see the instructor for specific program details.

GEP Global Knowledge
Typically offered in Spring only

ARE 495 Special Topics in Agricultural and Resource Economics (1-6 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis.

ARE 590 Special Topics in ARE (1-99 credit hours)
Special Topics in ARE

Agricultural Institute (AGI)

AGI 100 Enhancing Academic Success (1 credit hours)
This course is designed to introduce students to strategies for effective learning that will help them succeed at NC State University and in their future careers. Students will have the unique opportunity to participate in a class format that focuses on building academic as well as personal skills. This course provides one-on-one and small group interaction with the instructor to help individuals identify potential obstacles to their academic performance.

Typically offered in Fall and Spring

AGI 101 Introduction to the Agricultural Institute (1 credit hours)
Introduction to the collegiate experience; academic skills of successful students; curricula of the Agricultural Institute; career opportunities of graduates; introduction to computers.

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

AGI 120 Spanish For AG Stu (3 credit hours)
This is an introductory conversational Spanish course specifically designed for agricultural students. The main goal of this course is to give students some basic grammatical and communication skills so that they will be able to interact with Spanish speaking employees in different work environments and under different situations within their specific agricultural fields. This course does not satisfy the Foreign Language Proficiency Requirement of the GEP.

Requisite: Agricultural Institute Only
Typically offered in Fall only

AGI 134 Trends and Culture of the Agricultural Workforce (3 credit hours)
This course is designed to introduce students to cultural diversity; the value it adds to the agricultural workplace; and how to increase, improve, and support cultural diversity in the workplace. This course will challenge students to get to know people of other cultures on a personal and individual level, with hopes that they will then have an increased appreciation for cultural differences. In efforts to do that, this course will include topics such as: mental health and farmers; the banana massacre; appreciating others' first languages; history of the U.S. agricultural workforce; racial history in U.S. agriculture; stopping the stigma of black farmers; migrant farm labor and how we treat farm workers; and the importance of international relationships in global trade. Students who successfully complete this course will walk away with cultural diversity skills that will increase their effectiveness as managers and business owners in the agricultural industry.

Typically offered in Spring only

AGI 160 Computer Applications for Agricultural Operations (3 credit hours)
Businesses in the agricultural industry are looking to hire employees that have knowledge of computer applications relevant to business operations. This course will introduce students to applications necessary to run a successful agricultural operation. A focus of the course will be on Excel, since its use is instrumental to the business functions of agricultural operations. Other topics covered will include online marketing tools, online meeting platforms, and the use of social media to further the business goals of an agricultural operation.

Restriction: Agricultural Institute Students Only
Typically offered in Fall only

AGI 161 Agricultural Operations (3 credit hours)
Ag Operations is a three (3) credit hour course designed to introduce students to employability skills that are desired by employers in the agricultural industry according to current research. Students will learn about what is necessary to manage people through positive organizational behavior in the 21st century through a hands-on approach that includes lectures, discussions, case studies, and experiences outside of the classroom. The course will start with a focus on self-development, understanding how to work in a team, and conclude with how to successfully lead a team in an agricultural organization. Multiple in and out of class assignments will be assigned and students will complete a handbook to take into the workforce by the end of the course.

Restriction: Agricultural Institute Students Only
Typically offered in Fall only

AGI 191 Professional Development (1 credit hours)
Professional Development is designed to introduce students to various skills (as identified by current research) that employers feel are important for prospective employers to have. This course will provide students the opportunity to develop and practice these in a variety of contexts.

Typically offered in Fall, Spring, and Summer

AGI 192 AGI External Learning Experience (1-3 credit hours)
Learning experience in one of the six majors in the Agricultural Institute that utilizes facilities and resources external to the campus. Students can choose from multiple external learning experiences. Students who complete an external learning experience will have a unique opportunity to put to practice the skills and knowledge they have learned in the classroom in an external setting.

Prerequisite: Agricultural Institute Only and AGI 191
Typically offered in Fall, Spring, and Summer

AGI 193 AGI Special Problems and On-campus Learning (1-6 credit hours)
Learning experience in one of the eight majors in the Agricultural Institute that utilizes facilities and resources on the campus. (Contact with the project supervisor must be initiated by student and approved by the faculty adviser and the Director of the Agricultural Institute prior to the experience).

Requisite: Agricultural Institute Only
Typically offered in Fall, Spring, and Summer

AGI 194 International Learning Experience in AGI (1-6 credit hours)
Course offered as needed for international learning experiences in the Agricultural Institute involving international travel and immersion in an international culture. A written report is required and student must identify a faculty member to work with them. Travel expenses may be incurred by the student. Departmental approval required.

Requisite: Agricultural Institute Only
Typically offered in Spring only

AGI 195 Special Topics in the Agricultural Institute (1-4 credit hours)
Timely topical courses or experimental course offerings in the Agricultural Institute.

Requisite: Agricultural Institute Only
Typically offered in Fall, Spring, and Summer

Agriculture and Life Sciences (ALS)

ALS 103 Freshman Transitions and Diversity in Agriculture & Life Sciences (1 credit hours)
Introduction to scope and objectives of university education. Overview of curricula, academic requirements, and career opportunities in agriculture and life sciences. Overview of campus resources and support services. Discussion of expectations for academic and career success including professionalism, diversity, and inclusiveness. Restricted to CALS majors of freshman or sophomore status. Students will not receive credit for both ALS 103 and ALS 303.

Prerequisite: CALS Majors with less than 30 Credit Hours
GEP U.S. Diversity
Typically offered in Fall and Spring

ALS 110 Academic and Career Skills Seminar (1 credit hours)
Students learn about the career decision-making process through integration of self-knowledge. Emphasis is placed on Agriculture and Life Sciences careers. Students assess interests, values, skills and personal strengths while learning about a variety of campus and career resources.

Prerequisite: Ag and Life Science Majors
Typically offered in Spring only

ALS 303 Transfer Transitions and Diversity in Agriculture & Life Sciences (1 credit hours)
Introduction to scope and objectives of university education. Overview of curricula, academic requirements, and career opportunities in agriculture and life sciences. Overview of campus resources and support services. Discussion of expectations for academic and career success including professionalism, diversity, and inclusiveness. Restricted to CALS majors with 30 or more credit hours completed. Students will not receive credit for both ALS 103 and ALS 303.

R: CALS Majors >30 credits
GEP U.S. Diversity
Typically offered in Fall and Spring

ALS 398 Agriculture and Life Sciences Honors Seminar (2 credit hours)
A seminar/discussion honors course with emphasis on a team approach to scientific research into topics that link science with issues in society; exposure to leadership skills and bioethics; requirement of detailed written or oral reports; career development in the agricultural and life sciences; required participation in on- and off-campus scholarly retreats.

Prerequisite: Enrollment by invitation for sophomores or juniors in CALS with GPA 3.35 or higher.
Typically offered in Spring only

ALS 494 International Learning Experience in Agriculture and Life Sciences (1-6 credit hours)
Course offered as needed for international learning experiences in agriculture and life sciences involving international travel and immersion in an international culture. Travel expenses may be incurred by the student. Departmental Approval Required. Students will need to complete a program application through the NC State Study Abroad Office. Students enrolled in the summer will be required to take a one credit hour lecture section of ALS 494 in the spring of the same year. Department approval required, enroll with instructor's permission.

GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

ALS 495 Special Topics in Agriculture and Life Sciences (1-3 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ALS 496 International Research Experience (3 credit hours)
This summer research experience will provide students with the opportunity to sharpen their research skills while working side-by-side with scientists at international research stations. Students will conduct lab and/or field research depending on their international location. Students will experience full-cultural immersion during the research experience and will develop a strong understanding of the local culture. Some basic local language knowledge may be necessary depending on the location and research.

Typically offered in Fall, Spring, and Summer

ALS 498 Honors Research or Teaching I (1-3 credit hours)
Honors research or teaching for students in Agriculture and Life Sciences. First of a two-course sequence. Identification of a project and development of a proposal; literature search, planning, and work initiation. A maximum of 6 credits for ALS 498 & ALS 499 combined. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ALS 398, GPA 3.35 or higher
Typically offered in Fall, Spring, and Summer

ALS 499 Honors Research or Teaching II (1-4 credit hours)
Honors research or teaching for students in Agriculture and Life Sciences. Completion of work initiated in ALS 498. Analysis of results. Preparation and presentation of written and oral reports. A maximum of 6 credits for ALS 498 and ALS 499 combined. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ALS 498, GPA 3.35 or higher
Typically offered in Fall, Spring, and Summer

ALS 602 Preparing for a Career in Agriculture and the Life Sciences (1 credit hours)
This course provides graduate students with techniques, strategies, and opportunities to practice and develop skills beneficial to their professional development and transition from school to career. The course focuses on six competencies known to contribute to success in the workforce: teamwork and collaboration; oral communication; career management and self-development; giving and accepting feedback; global/intercultural fluency; and organizing, prioritizing, and delegating work. Students will examine their life trajectory to date and create a 5-year plan for personal and professional success; and be equipped with an understanding of the steps necessary to accomplish their professional goals.

Typically offered in Spring only

Animal Science (ANS)

ANS 101 Introduction to Livestock and Poultry Industries (3 credit hours)
General introduction to nutrition, reproduction, breeding, management and description of marketing channels of animals and poultry. Equates live animal and carcass characteristics with market specifications. Factors of pre- and post-slaughter treatment are related to the shelf life of fresh and processed meats. MCCRAW/GREGORY

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 102 Animal Feeds and Nutrition (3 credit hours)
Basics of animal nutrition and feeding. Identification and classification of common feedstuffs, including relative nutritional value for livestock and poultry. General nutrition and changes in requirements as influenced by production and the animal's life cycle. Applied aspects of feeding and nutrition of livestock and poultry. Agricultural Institute Students Only (Class= 01 or 02).

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 103 Beef Production (3 credit hours)
Genetics, reproduction, nutrition, animal health, forage management and marketing channels as related to beef cattle enterprises.

Requisite: Agricultural Institute Only
Typically offered in Fall only

ANS 104 Swine Production (4 credit hours)
Management principles associated with swine production. Primary emphasis on interactions of health, equipment, nutrition, reproduction and genetics during nursery, finishing, farrowing and breeding phases of production. Management of farrowing, finishing and farrow to finish operations. Emphasis on management kills, computer applications and economics.

Requisite: Agricultural Institute Only
Typically offered in Spring only

ANS 105 Introduction to Companion Animal Science (3 credit hours)
Companion animals are often considered family members. This course surveys the variation available in companion animals (dog breeds, cat breeds, fish, reptiles, amphibians, rabbits, pet pigs, ferrets, hamsters, gerbils, mice, rats, birds & newer pets such as hedgehogs, prairie dogs & sugar gliders) and then examines related human and animal issues in more depth. Biological explanations are stressed for understanding disease states and normal behaviors of companion animals. These explanations are discussed from the point of view of problem behaviors in the average home housing these animals. This course will help educate the students about companion animals so that both the animals and their human families will be happier and more productive members of society. ANS 105 will enable students to pick the pet or specific breed that is best for them so that pets and owners stay together. Restricted to Freshmen and Sophomores.

Restriction: Freshmen & Sophomores only
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

ANS 110 Introduction to Equine Science (3 credit hours)
Introduction to Equine Science is a course designed for Freshmen and Sophomores of any major. There are no pre-requisites for this course. We will discuss terminology, impact of horses on history and society, breeds, uses, management, genetics, reproduction, health, nutrition, behavior, and business aspects of the horse industry. Restricted to Freshmen and Sophomores.

Prerequisite: Freshman standing or Sophomore standing
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

ANS 150 Introduction to Animal Science (3 credit hours)
Introduction to the principles and physiology of animal management, the contributions of animals and animal products to humanity, the application of science to to animal production, and issues regarding animal production. The course includes biological aspects of animal science such as animal behavior, anatomical and physiological aspects of reproduction and nutrition, animal breeding and genetics, and human/animal interactions. Normal management and production techniques [including proper terminology] as well as social issues and current events related to livestock, equines, and companion mammals are discussed. Prerequisite: None. Course is 3 credits. Class meets Monday, Wednesday, and Friday 8:30 to 9:20 am in Fall and Spring, Internet only during the Summer. Fall semesters are restricted to new incoming Animal Science Freshmen. Open to all students in Spring and Summer.

Typically offered in Fall, Spring, and Summer

ANS 151 Introduction to Animal Science Lab (1 credit hours)
Hands-on experience and demonstrations with livestock and horses; identification of common management equipment and knowledge of proper use; animal tracts, organs, skulls, feeds, breeds, and other animal-related items or topics. The lecture (ANS 150) must be taken concurrently or have been passed previously with a C-minus or higher. This lab course is restricted to the following majors: Animal Science, Ag Extension, Ag Science, and Ag Education. Transportation is provided to the off-campus labs, and students will be returned to campus prior to the end of the scheduled lab period.

Corequisite: ANS 150; R: Animal Science or Ag Extension or Ag Science or Ag Education majors
Typically offered in Fall and Spring

ANS 201 Techniques of Animal Care (2 credit hours)
A laboratory course in the applied management of beef cattle, dairy cattle, equine, swine and small ruminants with required participatory assignments of common techniques utilized in livestock production. These techniques include but are not limited to castration, animal ID, and hoof trimming. Most of course will be held at the various Teaching Educational Units and will be held outdoors. Therefore, students should arrive for the course dressed appropriately for the lab activities and weather conditions of each day. Students will be working with animals, which comes with an inherent risk of injury. Students will be instructed on safety measures at the beginning of the semester and before each lab. Transportation will be provided to the scheduled course meetings but students will be required to provide their own transportation to the Teaching Educational Units for required assignments outside of class time.

Prerequisite: ANS 150 and ANS 151 (all ANS Majors) or ANS 101 (Ag Institute Livestock, Poultry Mgmt Program; Restriction: Junior or Senior Animal Science majors
Typically offered in Fall and Spring

ANS 205 Physiology of Domestic Animals (3 credit hours)
This course is designed to introduce students to mammalian physiology (structure and function) with emphasis on livestock species. Students will gain a basic understanding of body systems including circulatory, muscular, skeletal, digestive, and reproductive systems and functions of those systems with relevance to the whole animal and maintenance of homeostasis.

Prerequisite: (BIO 181 or BIO 183) and Sophomore standing
Typically offered in Fall, Spring, and Summer

ANS 206 Anatomy of Domestic Animals Lab (1 credit hours)
This lab course is designed for Animal Science majors to take with the ANS 205 lectures (Physiology of Domestic Animals). Students will learn to identify major anatomical and cellular structures from domestic animal (livestock) specimens through examination of gross and microscopic anatomy. SAS and IAS majors only.

Corequisite: ANS 205
Typically offered in Fall and Spring

ANS 208/PB 208/AEE 208 Agricultural Biotechnology: Issues and Implications (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183)
GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

ANS 215/HS 215 Agricultural Genetics (3 credit hours)
To provide an introduction to the science of genetics as applied to agriculture. Emphasis is given to qualitative and quantitative genetics. By the end of this course, students should be able to apply genetic concepts to efficiently solve problems and make predictions necessary for "real-life" agricultural situations.

Prerequisite: BIO 183 or equivalent or instructor's consent
GEP Natural Sciences
Typically offered in Fall only

ANS 220 Reproductive Physiology (3 credit hours)
Biological processes in reproduction and lactation with emphasis on domestic mammals such as cattle, sheep, goats, horses, swine, dogs, cand cats. Environmental and genetic factors that affect these processes. Identification, evaluation and solutions of problems in these physiological areas.

Prerequisite: ANS 205 or BIO 250 or ZO 250
Typically offered in Fall and Spring

ANS 221 Reproductive Physiology Lab (1 credit hours)
ANS 221 is a laboratory course that introduces students to the application of principles of reproduction and lactation in domestic mammals. Students must have either completed or concurrently be enrolled in ANS 220. This course is restricted to Animal Science majors (SAS, IAS).

Corequisite of ANS 220
Typically offered in Fall and Spring

ANS 225 Principles of Animal Nutrition (3 credit hours)
This online Principles of Animal Nutrition course is designed for non-Animal Science majors and off-campus students. It includes: feed classification, gastrointestinal tract anatomy of domestic mammals, nutrients and their functions, digestion and metabolism, feed regulations, and feeding/nutrition of cattle, small ruminants, horses, swine, poultry, dogs, cats, and rabbits. For on-campus students, ANS 225 counts toward the Animal Science minor but only counts as a Free Elective for Animal Science majors.

Typically offered in Summer only

ANS 230 Animal Nutrition (3 credit hours)
Introduction to nutrition, digestion, and absorption in domestic mammals. Major nutrient classes and their functions in the body, feed classification and chemical analysis, feed processing, and nutrient requirements.

Prerequisite: ANS 150 or BIO 183; ANS 205 is also recommended.
Typically offered in Fall and Spring

ANS 231 Animal Nutrition Lab (1 credit hours)
ANS 231 is a laboratory course that introduces students to the application of principles of nutrition and applied feeding of domestic mammals. Students must have either completed or concurrently be enrolled in ANS 230. This course is restricted to Animal Science Majors (SAS, IAS).

Corequisite: ANS 230
Typically offered in Fall and Spring

ANS 240/ANS 240A Livestock Merchandising (3 credit hours)
This course is designed to acquaint students with different methods for merchandising livestock and with strategies for adding value to products produced from livestock. Students will learn new ways to promote a farming operation. Required visits to Animal Educational Units outside of normal class time and student must provide own transportation. Required visits to Animal Educational Units outside of normal class time and student must provide own transportation. There are two required mandatory Saturday events. The animal auction held on the 3rd Saturday of April (2nd Saturday if Easter occurs on the 3rd weekend) and the Open House held either one or two Saturdays (varies depending on the Easter date) prior to the animal auction.

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Spring only

ANS 240A/ANS 240 Livestock Merchandising (3 credit hours)
This course is designed to acquaint students with different methods for merchandising livestock and with strategies for adding value to products produced from livestock. Students will learn new ways to promote a farming operation. Required visits to Animal Educational Units outside of normal class time and student must provide own transportation. Required visits to Animal Educational Units outside of normal class time and student must provide own transportation. There are two required mandatory Saturday events. The animal auction held on the 3rd Saturday of April (2nd Saturday if Easter occurs on the 3rd weekend) and the Open House held either one or two Saturdays (varies depending on the Easter date) prior to the animal auction.

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Spring only

ANS 260 Basic Swine Science (2 credit hours)
Basic disciplines and concepts involved in swine production including: industry structure, trends and statistics; production phases and buildings; genetic improvement; reproduction; nutrition; health and biosecurity; nutrient management; marketing, meat quality, and career opportunities in the swine industry.

Restriction: Non-ANS (Animal Science) students only. ANS students cannot take this course for credit.
Typically offered in Spring only

ANS 261 Swine Health and Biosecurity (1 credit hours)
Introduction and basic overview of the immune system, swine disease transmission and pathobiology, standard biosecurity protocols, identification of disease in pigs, basic treatment administration, and disease prevention.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 262 Swine Breeding and Gestation Management (1 credit hours)
Management principles associated with breeding and gestation in swine. Emphasis on reproductive anatomy and physiology of boars and sows, development of replacement animals, semen production and evaluation, artificial insemination, and use of reproductive records. Extensive use of reproductive case studies.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 263 Farrowing Management (1 credit hours)
Advanced integration and application of factors important in the proper care and management of swine during farrowing and lactation.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring and Summer

ANS 264 Swine Nursery and Finishing Management (1 credit hours)
Overview of the critical management, housing, and financial considerations relevant to the successful operation of a swine nursery, grow-finish, or wean to finish enterprise.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring and Summer

ANS 265 Contemporary Issues in the Swine Industry (1 credit hours)
Overview of current issues affecting pork production in the United States, including, but not limited to: environment, Swine welfare and profitability/ market issues. Development of skills to promote animal agriculture when dealing with the media and general public.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 266 Swine Environment Management (1 credit hours)
Course includes response of swine to thermal environment ventilation system design and analysis, heating and cooling, systems and examples of various designs for all phases of production. Troubleshooting and energy analysis will be included as well.

Prerequisite: ANS 150 or equivalent
Typically offered in Fall only

ANS 267 Swine Manure and Nutrient Management (1 credit hours)
Course includes manure production rates, manure handling systems, storage and manure management planning for land applications. Some odor mitigation technologies will be covered.

Prerequisite: ANS 150 or equivalent
Typically offered in Spring only

ANS 268 Employee Management for the Swine Industry (1 credit hours)
Effective employee management in swine production units. Principles, policies, and practices related to hiring, development and retention of employees, as well as fundamental organizational management.

Prerequisite: ANS 150 or equivalent
Typically offered in Fall only

ANS 269 Internship in the Swine Industry (1 credit hours)
Experiential learning in the swine industry through opportunities that provide hands-on experience and exposure to the scope of pork enterprises. Students can expect to apply principles and practices already learned, and add practical experience to their skill sets and knowledge base. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ANS 150 or equivalent
Typically offered in Summer only

ANS 270 Pork Export Markets from a Swine Production Perspective (1 credit hours)
Introduction to global markets; cultural preferences and customs associated with the global swine industry. International trade regulations and potential impact of foreign animal diseases and bioterrorism affecting the U.S. swine industry.

Prerequisite: ANS 150 or equivalent
Typically offered in Summer only

ANS 271 Swine Nutrition (1 credit hours)
Principles involved with developing and implementing a swine feeding program, including fundamentals of feeding pigs, understanding nutrients used in pig diets, factors affecting nutrient recommendations, feeding systems for pigs, feed ingredients, and formulation of swine diets.

Prerequisite: ANS 150 or ANS 260 or Equivalent Restriction: Restricted to non-ANS (Animal Science) students. ANS students cannot take the course for credit.
Typically offered in Fall only

ANS 281 Professional Development of PreVeterinary Track Students (1 credit hours)
This course introduces PreVeterinary track students to the scope of the veterinary profession and to current issues affecting veterinary professionals. The course will help students gain an understanding of the professional requirement of the veterinary school applications. Students will be expected to discuss current animal and public health issues as well as areas of national shortage in the veterinary profession. One Saturday at the NCSU vet school Open House is required (first Saturday in April).

Prerequisite: ZO 160 or BIO 125 or BIO 181 or BIO 183
Typically offered in Spring only

ANS 290 Professional Development for Animal Science Careers (2 credit hours)
This course will teach students how to navigate the career decision-making process to make an informed decision and discuss career options in the field of Animal Science. The course will also help students evaluate and develop their professional competencies and skills.

Animal Science Majors Only
Typically offered in Fall and Spring

ANS 303 Principles of Equine Evaluation (2 credit hours)
Students will learn about and apply methods for evaluating conformation and function of performance and halter horses, soundness, breed standards, rules and regulations for evaluation, selection, and performance. Guest lecturers and field trips.

Prerequisite: ANS 150 or ANS 110
Typically offered in Spring only

ANS 304 Dairy Cattle Evaluation (2 credit hours)
The first half of this course covers basic aspects of dairy cattle breeds, dairy character, form and function including type traits and linear scoring of dairy cattle, interpreting and using judging scorecards, comparing/evaluating dairy cattle, andplacing animals in a class. The second half of the course develops the student's ability to correctly evaluate dairy cattle classes, but more importantly to support their opinions through oral communication.

Prerequisite: ANS 150
Typically offered in Spring only

ANS 309 Livestock Evaluation (3 credit hours)
Students will be exposed to basic concepts associated with growth, development and value determination of livestock. Familiarization with official USDA grading standards for cattle, sheep, swine and goats is emphasized. Introduction to judging terminology, placing classes of livestock and justification through oral reasons.

Prerequisite: ANS 150
Typically offered in Spring only

ANS 322/FS 322/PO 322 Muscle Foods and Eggs (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processedmeat items.

Prerequisite: ZO 160, BIO 181 or BIO 183
Typically offered in Fall only

ANS 324/FS 324 Milk and Dairy Products (3 credit hours)
Introduction to the manufacture of dairy products. Dairy processing procedures from the farm, through the dairy plant, and to the consumer are studied. The course consists of 15 learning modules, three exams, and a project.

Prerequisite: BIO 181 or 183, CH 101
Typically offered in Fall only

ANS 330 Laboratory Animal Science (3 credit hours)
A sophomore to senior level course designed to cover the basics of laboratory animal science, a specialty dealing with the use of vertebrate animal species in intensive research. Some topics to be covered are: husbandry, facility management, animalhealth and welfare, diagnostics, surgical area management, research methods and administrative duties. Students will use the material for studying for the certification as a Laboratory Animal Technician via the American Association For Laboratory Animal Science (AALAS). A separate fee is required for certification; this fee is not covered by tuition for ANS 330. Must hold sophomore standing or higher.

Typically offered in Spring only

ANS 395 Animal Science Study Abroad (1-6 credit hours)
This course provides an international perspective on animal management, conservation and various animal-related industries by allowing students to study abroad in various locations around the world, with different destinations offered each academic year. Credit hours are variable based on length of travel and classroom instruction pre- and post-travel consistent with NCSU policies and practices. Course may be repeated for credit to visit different destinations only. Significant expenses for travel are involved. Please consult with the instructor or the Study Abroad Office for specific program details.

GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

ANS 400 Companion Animal Management (3 credit hours)
Anatomy, physiology, nutrition, genetics, and health of companion animals including cats, dogs, rabbits, rats, mice, reptiles, amphibians, and fish. Problem solving and enterprise management skills in laboratories.

Prerequisite: ANS 105 and Junior standing
Typically offered in Spring only

ANS 402 Beef Cattle Management (3 credit hours)
ANS 402 integrates technical information from nutrition, reproduction, genetics, physiology, and animal welfare into management decisions that will enhance a beef cattle operation. Students will engage in beef cattle and environmental management and varied communication formats to explore relationships between sectors of the beef industry from cow-calf to the consumer.

Prerequisite: ANS 150, Junior standing
Typically offered in Spring only

ANS 403 Swine Management (3 credit hours)
Management principles associated with swine production. Emphasis on interactions of health, equipment, nutrition, reproduction and genetics during nursery, finishing, farrowing and breeding phases of production. Waste management practices and alternatives, development of marketing strategies and economic evaluation of management practices.

Prerequisite: ANS 150; Restrictive Statement: Students must be Juniors or Seniors
Typically offered in Fall only

ANS 404 Dairy Cattle Management (3 credit hours)
In ANS 404, students will develop a better understanding of dairy cattle management with an emphasis on the impact of decisions on productivity, health, profitability, and the future of the dairy enterprise.

Prerequisite: ANS 150, Junior standing
Typically offered in Spring only

ANS 407 Livestock Grazing Management (3 credit hours)
This course is an overview of scientific principles applied in managing grazing livestock species (e.g., beef cattle, horses, sheep and goats) with an emphasis on promoting animal health, plant health and production efficiency. Topics include grazing behavior of livestock, nutritional aspects of pasture, effect of grazing on plant and soil health, plant identification, pasture allocation, pasture systems for each livestock species (beef cattle, horse, sheep and goats), multi-species grazing systems, watering systems, fencing, and economics of grazing. The course will be conducted as hybrid using asynchronous online lectures and one three-hour lab per week. Students will be required to provide their own transportation to lab. Non-scheduled class time for field trips or out-of-class activities is NOT required for this class.

P: ANS 150 and ANS 151 and ANS 230
Typically offered in Fall only

ANS 408 Small Ruminant Management (3 credit hours)
Principles and practices of production, management, and marketing of sheep and goats. Role of genetics, nutrition, reproduction and animal health. Hands-on experience and field trips during labs.

Prerequisite: ANS 150, Junior standing
Typically offered in Fall and Spring

ANS 410 Equine Breeding Farm Management (3 credit hours)
Equine anatomy, physiology, nutrition, genetics and health. Laboratory emphasis on reproductive management, breeding, problem solving, and management skills. Field trips required.

Prerequisite: ANS 110 and Junior standing
Typically offered in Spring only

ANS 411 Management of Growing and Performance Horses (3 credit hours)
This course is an overview of scientific applications used in management of growing and performance horses. Topics include: nutrition and feeding, disease prevention, exercise conditioning, and methods of evaluation and selection. Students required to provide their own transportation to labs. Must hold junior or senior standing.

Prerequisite: ANS 110
Typically offered in Fall only

ANS 415/NTR 415/PO 415/PO 515/NTR 515/ANS 515 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525/PO 525/ NTR 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

ANS 435/ANS 535 Stress Physiology in Animals (3 credit hours)
Stress Physiology in Animals is a course focusing on the mechanism whereby stress impacts multiple physiological systems throughout the body in animals (human and non-human models). Physiological systems discussed will include the hypothalamic-pituitary-adrenal axis, the nervous system, the cardiovascular system, the respiratory system, the immune system, the metabolic system, and the reproduction system.

Prerequisite: ANS 205 or ZO 250
Typically offered in Spring only

ANS 440/ANS 540 Animal Genetic Improvement (3 credit hours)
Modern evaluation and selection procedures for domestic animals; selection goals, estimation of breeding values and performance testing; their impact on genetic changes.

Prerequisite: (ANS/HS 215 or GN 311) and (ST 311 or ST/BUS 350) and Junior standing
Typically offered in Fall and Summer

ANS 452/ANS 552/PHY 552/PHY 452 Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit will not be given for both ANS 452 and ANS (PHY) 552.

Prerequisite: ANS 220
Typically offered in Fall only

ANS 453/ANS 553 Physiology and Genetics of Growth and Development (3 credit hours)
Introduction to the basic concepts of growth with emphasis on domestic mammals. Growth of the major classes of animal tissues and regulation by endogenous and exogenous factors. Relationship to efficiency of animal production. Credit will not be given for both ANS 453 and 553.

Typically offered in Fall only

ANS 454/NTR 454/ANS 554 Lactation, Milk and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

ANS 480 Judging Team (1 credit hours)
Students practice judging techniques for livestock, horses, or dairy animals, including ranking animals and providing oral reasons to defend the rankings. Students meet weekly with a coach to practice locally and will also travel to compete in one or two regional or national competitions. Each team (livestock, horse, dairy) is expected to raise funds to finance the trips. Students earn 1 credit for being on a team, and can earn up to 3 credits of Free Elective for ANS 480 by serving on the judging team for different species. Field trips that last several days are required. Departmental Approval Required. Course may be taken up to 3 times (once per species).

Prerequisite: ANS 303 or ANS 304 or ANS 309
Typically offered in Fall only

ANS 492 Professional Internship Experience in the Animal Sciences (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Department of Animal Science prior to the start of the experience. To gain approval, a student must submit the completed ANS 492 contract and have it approved by his/her experience supervisor, academic advisor and the ANS 492 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

ANS 493 Research Experience in the Animal Sciences (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Department of Animal Science prior to the start of the experience. To gain approval, a student must submit the completed ANS 493 contract and have it approved by his/her research supervisor, academic advisor and the ANS 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

ANS 494 Teaching Experience in the Animal Sciences (1-3 credit hours)
This course provides an opportunity for students to gain experience with some aspect of teaching, including: leading or facilitating lessons, producing educational resources, or education research. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Animal Science Department prior to the start of the experience. To gain approval, a student must submit the completed ANS 494 contract and have it approved by his/her research supervisor, academic advisor and the ANS 494 coordinator. If the experience involves education research, the research mentor is encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

ANS 495 Special Topics in Animal Science (1-3 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ANS 515/ANS 415/NTR 415/PO 415/PO 515/NTR 515 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425/NTR 525/ FM 525 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

ANS 535/ANS 435 Stress Physiology in Animals (3 credit hours)
Stress Physiology in Animals is a course focusing on the mechanism whereby stress impacts multiple physiological systems throughout the body in animals (human and non-human models). Physiological systems discussed will include the hypothalamic-pituitary-adrenal axis, the nervous system, the cardiovascular system, the respiratory system, the immune system, the metabolic system, and the reproduction system.

Prerequisite: ANS 205 or ZO 250
Typically offered in Spring only

ANS 540/ANS 440 Animal Genetic Improvement (3 credit hours)
Modern evaluation and selection procedures for domestic animals; selection goals, estimation of breeding values and performance testing; their impact on genetic changes.

Prerequisite: (ANS/HS 215 or GN 311) and (ST 311 or ST/BUS 350) and Junior standing
Typically offered in Fall and Summer

ANS 550/NTR 550 Applied Ruminant Nutrition (3 credit hours)
Applied concepts in ruminant nutrition for the practicing agricultural professional. Protein, energy, vitamin and mineral nutrition in relation to the nutritional needs and practical feeding of beef cattle, dairy cattle, sheep, and goats. New developments in feeding systems, feed additives and the prevention and treatment of metabolic disorders. Emphasis on solving problems in case studies. Permission given to undergraduates

Prerequisite: ANS 230 or ANS(NTR,PO) 415. Permission given to undergraduates
Typically offered in Fall only

ANS 552/PHY 552/PHY 452/ANS 452 Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit will not be given for both ANS 452 and ANS (PHY) 552.

Prerequisite: ANS 220
Typically offered in Fall only

ANS 553/ANS 453 Physiology and Genetics of Growth and Development (3 credit hours)
Introduction to the basic concepts of growth with emphasis on domestic mammals. Growth of the major classes of animal tissues and regulation by endogenous and exogenous factors. Relationship to efficiency of animal production. Credit will not be given for both ANS 453 and 553.

Typically offered in Fall only

ANS 554/ANS 454/NTR 454 Lactation, Milk and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

ANS 561/NTR 561 Equine Nutrition (3 credit hours)
This course explores concepts in equine nutrition including digestive physiology of horses, nutrient requirements for different classes of horses and feed management. Ration evaluation and balancing, as well as problem solving will be a core component to this course.

Prerequisite:NTR 500 or NTR/FS 501 or NTR/PO 515
Typically offered in Spring only

ANS 565/NTR 565 Advanced Canine and Feline Nutrition (3 credit hours)
This course is about the advanced principles of nutrition within canines and felines. The course focuses on the unique gastro- intestinal tracts for the two species as well as their specific nutrient requirements and how the animal industry addresses these needs.

Restriction: Graduate Student or Senior with 3.35 GPA; Prerequisite: 400-level Nutrition Course
Typically offered in Fall only

ANS 571/BCH 571 Regulation of Metabolism (3 credit hours)
Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.

Prerequisite: BCH 451, GN 311, a course in physiology, cell biology
Typically offered in Fall only

ANS 590 Topical Problems in Animal Science (1-3 credit hours)
Selection or assignment of special problems in various phases of animal science.

Typically offered in Fall and Spring

ANS 591 Special Topics in Animal Science through AG Idea (1-3 credit hours)
Special topics in various aspects of animal science offered via Great Plains AG Idea.

Typically offered in Fall, Spring, and Summer

ANS 600 Professional Development for Graduate Students (1 credit hours)
This course is designed to assist graduate students with the preparation of professional information that they may be required to provide as they seek opportunities following graduate school. Course topics will include preparation of personal statements, resumes or curriculum vitae, investigation of the types of careers available to Animal Science graduates, and preparation of multimedia presentations that may be used in formal interviews.

Restriction: Graduate Standing
Typically offered in Spring only

ANS 601 Animal Science Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

ANS 603 Reproductive Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Spring only

ANS 604 Animal Breeding and Genetics Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

ANS 610 Topical Problems in Animal Science (1-6 credit hours)
Selection or assignment of special problems in various phases of animal science.

Typically offered in Fall, Spring, and Summer

ANS 641 Practicum in Animal Science (1-3 credit hours)
Typically offered in Fall and Spring

ANS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

ANS 690 Master's Exam (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ANS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ANS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ANS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ANS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ANS 701/NTR 701 Protein and Amino Acid Metabolism (3 credit hours)
Study of protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals.

Prerequisite: BCH 453, ZO 421, a 400-level nutrition course
Typically offered in Spring only

ANS 702/PHY 702 Reproductive Physiology of Mammals (3 credit hours)
Survey of reproductive strategies among vertebrates; in-depth coverage of mammalian reproductive physiology; gametogenesis, fertilization, embryonic and fetal development, parturition, puberty, neuroendrocrine control mechanisms in male and female mammals.

Prerequisite: ZO 421
Typically offered in Fall and Spring

ANS 713/GN 713 Quantitative Genetics and Breeding (3 credit hours)
Quantitative and population genetic theory of breeding problems; partitioning of genetic variance, maternal effects, genotype by environment interaction and genetic correlation; selection indexes; design and analysis of selection experiments; marker-assisted selection.

Prerequisite: GN 509, ST 512
Typically offered in Spring only

ANS 726/FOR 726/CS 726 Advanced Topics In Quantitative Genetics and Breeding (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Spring only

ANS 780/PHY 780 Mammalian Endocrinology (3 credit hours)
Mammalian endocrine system with emphasis on ontogeny and anatomy of key organs; synthesis and action of hormones. Role of hormones in regulation of physiological processes such as metabolism, exocrine function, digestion, ion balance, behavior, lactation, growth and reproduction.

Prerequisite: BCH 451, ZO 421

ANS 790 Advanced Special Topics in Animal Science (1-6 credit hours)
Selection or assignment of advanced special problems in various disciplines of animal science.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

ANS 803 Reproductive Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Spring only

ANS 804 Animal Breeding and Genetics Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

ANS 810 Topical Problems in Animal Science (1-6 credit hours)
Selection or assignment of special problems in various phases of animal science.

Typically offered in Fall, Spring, and Summer

ANS 811 Safety and Ethics in Animal Science (1 credit hours)
ANS 811 is 1 credit hour course focused on safety and ethics in the Department of Animal Science.

P: Graduate Standing
Typically offered in Fall only

ANS 841 Practicum in Animal Science (1-3 credit hours)
Typically offered in Fall and Spring

ANS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ANS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ANS 896 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ANS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Anthropology (ANT)

ANT 251 Physical Anthropology (3 credit hours)
Study of human evolution. Processes of evolution, human variation and race, behavior and morphology of nonhuman primates, and the fossil record. Emphasis on the study of human biosocial adaptation, past and present, and on humans as culture-bearing primates.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ANT 252 Cultural Anthropology (3 credit hours)
Comparative study of contemporary human culture, social institutions and processes that influence behavior. The range of human cultural variation shown throughout the world, including the student's own cultural system.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ANT 253 Unearthing the Past: Introduction to World Archaeology (3 credit hours)
World-wide survey of origins of human society, technology and culture in Old Stone Age, and origins of agriculture, cities, and civilizations of the Bronze and Iron Age in Europe, Asia, Africa, and pre-Columbian Middle and South America.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

ANT 254 Language and Culture (3 credit hours)
Focus among the aspects of human language and between aspects of language and culture. Topics such as: descriptive and comparative linguistics, structuralism, language and thought, sociolinguistics, bilingualism, culture change and linguistic changes.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

ANT 261/SOC 261 Technology in Society and Culture (3 credit hours)
Processes of social and cultural change with a focus on role of technological innovation. Cross-cultural emphasis. Workplace changes and societal risks in U.S. and non-U.S. societies associated with technological innovations. Special attention to the role of scientists and engineers in socio-cultural change. Topical case studies apply course concepts and principles. Core sociological and anthropological concepts, methods, theories.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

ANT 295 Special Topics in Anthropology (1-3 credit hours)
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ANT 310 Native Peoples and Cultures of North America (3 credit hours)
Native North American peoples and cultures including Eskimos and Aleuts. Theories of origin and selected prehistoric cultural manifestations. People and cultures at the time of European contact and post-contact cultural change. Contemporary problems and prospects.

Prerequisite: ANT 252 or HI 365
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

ANT 315 The Aztecs, Maya, and Their Predecessors: Archaeology of Mesoamerica (3 credit hours)
This course introduces the peoples and cultures of Mesoamerica from prehistoric times to the Colonial period. Themes include the peopling of the New World, the development of agriculture and social inequity, and the rise of states and empires. Covers the cultures of the Olmec, Maya, Zapotec, and Aztec as well as the ongoing importance of these cultures for the people of Mexico and Central America. Introduces primary archaeological and ethnohistoric sources and the anthropological approach to understanding people and cultures through their material remains.

Prerequisite: 3 credits of 200-level Anthropology, or HI 215, or HI 216
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 325 Andean South America (3 credit hours)
The societies, cultures, politics, economics and ecology of the Andean countries of South America (Peru, Bolivia, Ecuador, Chile, Colombia). Special attention is paid to the development of pre-Columbian Andean societies.

Prerequisite: ANT 252 or HI 215 or HI 216
GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

ANT 330 People and Cultures of Africa (3 credit hours)
Course offers an introduction to the anthropological study of Africa. Focus is on African people and cultures, especially in sub-Saharan Africa, including past and present social patterns of indigenous African populations from a cross-cultural perspective.

P: ANT 252 or HI 275 or HI 276
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 345 Anthropology of the Middle East (3 credit hours)
An introduction to the anthropology of Middle Eastern societies. Themes include religion and secularism, gender and sexuality, national identity and the state, memory and commemoration, violence and conflict, youth culture, and popular uprisings.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

ANT 346 Peoples and Cultures of Southeast Asia (3 credit hours)
Southeast Asian peoples and cultures; past and present social patterns of selected mainland and insular Southeast Asian peoples; culture change; relations between minorities and dominant ethnic groups; development of nationalism.

Prerequisite: ANT 252
Typically offered in Fall only

ANT 351/FLJ 351 Contemporary Culture in Japan (3 credit hours)
Introduction to basic aspects of cultural practices in Japanese society, including education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Students will develop an understanding of the interrelationships between language and culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ANT 354 Peoples and Cultures of the Pacific (3 credit hours)
The Pacific Ocean contains thousands of inhabited islands. This course examines the millions of people and thousands of societies that live in the Pacific and its three subregional areas Melanesia, Micronesia and Polynesia. Course topics include the Pacific environment, peopling of the Pacific, regional cultural variation, social organization, Exchange systems, politics, conflict, modernization, globalization and global warming in the Pacific region.

Prerequisite: ANT 252
Typically offered in Spring only

ANT 370 Introduction to Forensic Anthropology (3 credit hours)
Provides a broad overview of forensic anthropology, an applied field of biological anthropology. Students will apply the science of biological anthropology to the legal process and humanitarian arena. Students will identify skeletal remains to determine age, sex, ancestry, stature, and unique features of a decedent. Course will address general identification techniques, but proficiency is not expected.

GEP Social Sciences
Typically offered in Fall and Spring

ANT 371 Human Variation (3 credit hours)
Survey of basic principles of population genetics with emphasis on mechanisms that shape human biological variation. Geographic variation. Analysis of laws of heredity exhibited in modern human populations via microevolution and adaptation. Historical development of concepts with specific application to physical and forensic anthropology. Discussion of most current research.

Prerequisite: ANT 251
GEP Global Knowledge
Typically offered in Fall only

ANT 374 Disease and Society (3 credit hours)
Survey of diseases that affect human beings and human societies past and present. Analysis of how diseases affect societies with different economies (gathering/hunting, pastoral, agricultural, industrial) and of different social complexity. Impactof diseases on human evolution.

Prerequisite: ANT 251 or ANT 252

ANT 389 Fundamentals of Archaeological Research (3 credit hours)
Overview of the objectives, field strategies, basics of laboratory analysis, and interpretative approaches to the archaeological record. Analysis and classification of lithics, shell, bone, ceramics, metal, soils, and perishable materials.

Prerequisite: ANT 253 or Instructor Permission
Typically offered in Summer only

ANT 395 Special Topics in Anthropology (1-3 credit hours)
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

Prerequisite: 3 credits of 200-level Anthropology
Typically offered in Fall, Spring, and Summer

ANT 411/ANT 511 Overview of Anthropological Theory (3 credit hours)
A detailed introduction to anthropological theory, interpretive styles and research techniques of major nineteenth and twentieth century anthropologists working within the analytic frameworks of their times, positions espoused by anthropologists in contemporary debates concerning the discipline's future. Students cannot receive credit for both ANT 411 and ANT 511.

Prerequisite: ANT 252 and ANT 310 or ANT 325 or ANT 330 or ANT 345 or ANT 346 or ANT 354
Typically offered in Spring only

ANT 412/ANT 512 Applied Anthropology (3 credit hours)
History, aims, methods and ethics of applied anthropology. Anthropological practice in government, industry, community development, education, and medicine. Analysis of consequences of development programs for culture change. Credit cannot be given for both 412 and 512.

Typically offered in Spring only

ANT 416/ANT 516 Research Methods in Cultural Anthropology (3 credit hours)
A systematic overview of cultural anthropological research methods including designing research projects, research techniques, field work methods, and cross-cultural comparison. Reviews relevant ethical questions and anthropologists' reports of their own field work.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330, 345, 346, 351, or 354
Typically offered in Fall only

ANT 419 Ethnographic Field Methods (3 credit hours)
Ethnographic research methods as part of a summer field school abroad. Topics: research design, participant observation, field note writing, interviewing, sampling, coding, computers in ethnographic research, analysis and ethics.

Prerequisite: Six hours of cultural anthropology
Typically offered in Summer only

ANT 421/ANT 521 Human Osteology (3 credit hours)
Survey of all the bones of the human skeleton from an anthropological perspective, including their names, important features useful in recognizing fragmentary specimens from an archaeological context, and techniques for determining the side of the body they come from. Skeletal development and its relationship to skeletal abnormalities. Issues relating to the study of archaeological skeletons.

Prerequisite: ANT 251 and any ANT 300 Level
Typically offered in Fall only

ANT 424/ANT 524 Bioarchaeology (3 credit hours)
Survey of approaches used by bioarchaeologists to understand past lifeways through the study of excavated human remains, and the theories that inform those approaches. Analysis and critique of the ways in which bioarchaeologists use skeletal and mortuary data to reconstruct health and disease patterns, mortality rates, diet, degree of interpersonal violence, and social structure among humans from the distant past.

Prerequisite: ANT 421
Typically offered in Spring only

ANT 427 Bioarchaeological Fieldwork (3 credit hours)
An introduction to the bioarchaeology of the local region, and an overview of the objectives, field strategies, ad laboratory methods used by bioarchaeologists to prepare and study human remains from archaeological cemeteries. Includes laboratory work on field osteology and processing of skeletal remains. Provides an understanding of how bioarchaeologists proceed from excavation of osteological remains to preparation and analysis. Course is offered as part of an NCSU Study Abroad Program. All costs associated with the course, except for textbooks, are paid via the Study Abroad Program fee.

Prerequisite: ANT 421
Typically offered in Summer only

ANT 428/ANT 528 Human Paleopathology (3 credit hours)
Survey of diseases that manifest on the human skeleton. Analysis and identification of these diseases from a clinical perspective through all life stages from radiographic analysis, macroscopic analysis, and photographic analysis.

Prerequisite: ANT 251
Typically offered in Spring only

ANT 431/ANT 531 Tourism, Culture and Anthropology (3 credit hours)
Anthropological approach to tourism studies with emphasis on cross-cultural aspects of international tourism. Attention to impact of mass tourism as compared to alternative tourism; environmental and economic impact of tourism; impact of international tourists and tourism on local communities. Principal theories of leisure in relation to tourism. Theories of culture change in relation to travel and tourism. Credit not given for both ANT 431 and ANT 531.

Prerequisite: Three hours of cultural anthropology
Typically offered in Fall and Summer

ANT 433/ANT 533 Anthropology of Ecotourism and Heritage Conservation (3 credit hours)
Introduction to how cultures and societies view, utilize, interpret, manage and conserve environmental and cultural heritage resources; includes examination of theory and concepts of place, identity, sacred heritage, ecotourism, wildlife management as well as the cultural politics and practices of environmentalist and heritage management. Some limited travel to NC heritage sites required at student expense.

Prerequisite: ANT 252
Typically offered in Spring only

ANT 444/WGS 444/ANT 544/WGS 544 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 450/ANT 550 Culture, Ecology, and Sustainable Living (3 credit hours)
Examines the myriad ways that culture serves to mediate the human-environmental equation. Focus is given to different belief systems, subsistence strategies, technological achievements, and policy formulations. Topics covered include cultural ecology, gender and the environment, land tenure, development, ethnoscience and cognitive ecology, subsistence and social organization, historical and political ecology, environmentalism, and environmental policy issues.

Prerequisite: One of the following: ANT 310,325,330 or 346

ANT 460/ANT 560 Urban Anthropology (3 credit hours)
Anthropological study of cities. Examination of cross-cultural patterns of behavior in urban areas and adaptive strategies that urban dwellers employ. Introduction to major theoretical and methodological approaches relevant to an understanding of contemporary urbanization.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Fall only

ANT 461/ANT 561 Wealth, Poverty and International Aid (3 credit hours)
Examines notions of wealth and poverty in a variety of cultural settings, as well as ideas of whether and how people categorized as poor or rich might alter their status. These findings are applied to case studies of current international aid organizations that carry out poverty relief.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 464/ANT 564 Anthropology of Religion (3 credit hours)
Examination of various anthropological perspectives on the role of religion in social life, and discussion of theoretical and methodological issues pertaining to the study of ritual and belief.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 471/IS 471/ANT 571 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

ANT 475/ANT 575 Environmental Archaeology (3 credit hours)
Archaeological investigation of human-environmental interactions and human impacts on ancient environments. Focuses on the causes of environmental change (climate, human activity) and the implications for understanding human nature, predicting future problems, and addressing current crises. Topics include reconstructing paleoclimate, the extinction of megafuana, anthropogenic landscapes, environmental degradation and the collapse of ancient states, sustainability and the Anthropocene.

Prerequisites:ANT 253 and one 300-level anthropology course
Typically offered in Fall and Spring

ANT 481/ANT 581 Zooarchaeology (3 credit hours)
Survey of approaches used by archaeologists to understand the human past through the study of excavated animal remains, and the theories that inform those approaches. Analysis and critique of the ways in which archaeologists use animal remains to reconstruct past human economic systems, social identities, environments, hunting practices, domestication, and foodways. Includes analysis and identification of animal remains; zooarchaeological sampling, measurement, and quantification; and computer analysis of animal bone data to address archaeological questions.

Prerequisite: ANT 253
GEP Social Sciences
Typically offered in Spring only

ANT 483/ANT 583 Theories of Archaeological Research (3 credit hours)
Covers the theories that inform archaeological research in the effort to locate and interpret material evidence about past human activities. Topics include the history of archaeology, theories of archaeological practice and interpretation, ethics, and working with stakeholders. Relies on case studies and major syntheses and critiques of current theoretical debates. Cases focus on the origins of social complexity, human-environmental interactions, and critical perspectives on inequality, race, class, gender, and ethnicity. Students may not receive credit for both ANT 483 and ANT 583.

Typically offered in Fall only

ANT 495 Special Topics in Anthropology (3 credit hours)
Detailed investigation of a topic in anthropology. Topic and mode of study determined by faculty member(s).

ANT 496 Anthropology Internship (6 credit hours)
Supervised observation and experience in work settings appropriate to anthropological perspectives. Study of the relationships between internship setting and relevant anthropological theory, methods and research. Weekly seminars, individual conferences and an integrative report. Students are responsible for arranging their own transportation to internship sites. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: ANT 412, ANT 416; Senior standing in Anthropology (B.A.)
Typically offered in Fall and Spring

ANT 498 Independent Study in Anthropology (1-6 credit hours)
Independent study of a topic in anthropology. Topic and mode of study determined by faculty member(s) and student(s). Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Six hours of ANT
Typically offered in Fall, Spring, and Summer

ANT 501 Proseminar: Introduction to Graduate Studies in Anthropology (3 credit hours)
Introduction to anthropological research process; introduction to anthropology faculty; research proposal design; career planning; professional development; campus resources.

R: Anthropology Graduate students
Typically offered in Fall only

ANT 511/ANT 411 Overview of Anthropological Theory (3 credit hours)
A detailed introduction to anthropological theory, interpretive styles and research techniques of major nineteenth and twentieth century anthropologists working within the analytic frameworks of their times, positions espoused by anthropologists in contemporary debates concerning the discipline's future. Students cannot receive credit for both ANT 411 and ANT 511.

Prerequisite: ANT 252 and ANT 310 or ANT 325 or ANT 330 or ANT 345 or ANT 346 or ANT 354
Typically offered in Spring only

ANT 512/ANT 412 Applied Anthropology (3 credit hours)
History, aims, methods and ethics of applied anthropology. Anthropological practice in government, industry, community development, education, and medicine. Analysis of consequences of development programs for culture change. Credit cannot be given for both 412 and 512.

Typically offered in Spring only

ANT 516/ANT 416 Research Methods in Cultural Anthropology (3 credit hours)
A systematic overview of cultural anthropological research methods including designing research projects, research techniques, field work methods, and cross-cultural comparison. Reviews relevant ethical questions and anthropologists' reports of their own field work.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330, 345, 346, 351, or 354
Typically offered in Fall only

ANT 521/ANT 421 Human Osteology (3 credit hours)
Survey of all the bones of the human skeleton from an anthropological perspective, including their names, important features useful in recognizing fragmentary specimens from an archaeological context, and techniques for determining the side of the body they come from. Skeletal development and its relationship to skeletal abnormalities. Issues relating to the study of archaeological skeletons.

Prerequisite: ANT 251 and any ANT 300 Level
Typically offered in Fall only

ANT 524/ANT 424 Bioarchaeology (3 credit hours)
Survey of approaches used by bioarchaeologists to understand past lifeways through the study of excavated human remains, and the theories that inform those approaches. Analysis and critique of the ways in which bioarchaeologists use skeletal and mortuary data to reconstruct health and disease patterns, mortality rates, diet, degree of interpersonal violence, and social structure among humans from the distant past.

Prerequisite: ANT 421
Typically offered in Spring only

ANT 528/ANT 428 Human Paleopathology (3 credit hours)
Survey of diseases that manifest on the human skeleton. Analysis and identification of these diseases from a clinical perspective through all life stages from radiographic analysis, macroscopic analysis, and photographic analysis.

Prerequisite: ANT 251
Typically offered in Spring only

ANT 529 Advanced Methods in Forensic Anthropology (4 credit hours)
Advanced methods in forensic anthropology-an applied field of biological anthropology. Application of the science of biological anthropology to the medicolegal process. Identification of skeletal remains to determine age, sex, ancestry, stature, andunique features of a decedent. Analysis of human skeletal remains. Identification techniques addressed and proficiency expected. Students must provide their own transportation to the laboratory site.

Prerequisite: Graduate Standing
Typically offered in Spring only

ANT 531/ANT 431 Tourism, Culture and Anthropology (3 credit hours)
Anthropological approach to tourism studies with emphasis on cross-cultural aspects of international tourism. Attention to impact of mass tourism as compared to alternative tourism; environmental and economic impact of tourism; impact of international tourists and tourism on local communities. Principal theories of leisure in relation to tourism. Theories of culture change in relation to travel and tourism. Credit not given for both ANT 431 and ANT 531.

Prerequisite: Three hours of cultural anthropology
Typically offered in Fall and Summer

ANT 533/ANT 433 Anthropology of Ecotourism and Heritage Conservation (3 credit hours)
Introduction to how cultures and societies view, utilize, interpret, manage and conserve environmental and cultural heritage resources; includes examination of theory and concepts of place, identity, sacred heritage, ecotourism, wildlife management as well as the cultural politics and practices of environmentalist and heritage management. Some limited travel to NC heritage sites required at student expense.

Prerequisite: ANT 252
Typically offered in Spring only

ANT 544/WGS 544/ANT 444/WGS 444 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 550/ANT 450 Culture, Ecology, and Sustainable Living (3 credit hours)
Examines the myriad ways that culture serves to mediate the human-environmental equation. Focus is given to different belief systems, subsistence strategies, technological achievements, and policy formulations. Topics covered include cultural ecology, gender and the environment, land tenure, development, ethnoscience and cognitive ecology, subsistence and social organization, historical and political ecology, environmentalism, and environmental policy issues.

Prerequisite: One of the following: ANT 310,325,330 or 346

ANT 560/ANT 460 Urban Anthropology (3 credit hours)
Anthropological study of cities. Examination of cross-cultural patterns of behavior in urban areas and adaptive strategies that urban dwellers employ. Introduction to major theoretical and methodological approaches relevant to an understanding of contemporary urbanization.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Fall only

ANT 561/ANT 461 Wealth, Poverty and International Aid (3 credit hours)
Examines notions of wealth and poverty in a variety of cultural settings, as well as ideas of whether and how people categorized as poor or rich might alter their status. These findings are applied to case studies of current international aid organizations that carry out poverty relief.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

ANT 564/ANT 464 Anthropology of Religion (3 credit hours)
Examination of various anthropological perspectives on the role of religion in social life, and discussion of theoretical and methodological issues pertaining to the study of ritual and belief.

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

ANT 571/ANT 471/IS 471 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

ANT 575/ANT 475 Environmental Archaeology (3 credit hours)
Archaeological investigation of human-environmental interactions and human impacts on ancient environments. Focuses on the causes of environmental change (climate, human activity) and the implications for understanding human nature, predicting future problems, and addressing current crises. Topics include reconstructing paleoclimate, the extinction of megafuana, anthropogenic landscapes, environmental degradation and the collapse of ancient states, sustainability and the Anthropocene.

Prerequisites:ANT 253 and one 300-level anthropology course
Typically offered in Fall and Spring

ANT 581/ANT 481 Zooarchaeology (3 credit hours)
Survey of approaches used by archaeologists to understand the human past through the study of excavated animal remains, and the theories that inform those approaches. Analysis and critique of the ways in which archaeologists use animal remains to reconstruct past human economic systems, social identities, environments, hunting practices, domestication, and foodways. Includes analysis and identification of animal remains; zooarchaeological sampling, measurement, and quantification; and computer analysis of animal bone data to address archaeological questions.

Prerequisite: ANT 253
GEP Social Sciences
Typically offered in Spring only

ANT 583/ANT 483 Theories of Archaeological Research (3 credit hours)
Covers the theories that inform archaeological research in the effort to locate and interpret material evidence about past human activities. Topics include the history of archaeology, theories of archaeological practice and interpretation, ethics, and working with stakeholders. Relies on case studies and major syntheses and critiques of current theoretical debates. Cases focus on the origins of social complexity, human-environmental interactions, and critical perspectives on inequality, race, class, gender, and ethnicity. Students may not receive credit for both ANT 483 and ANT 583.

Typically offered in Fall only

ANT 585 Skeletal Biology in Anthropology (3 credit hours)
Skeletal biology is the study of human skeletal remains; understanding past populations' demographics, health and disease, physical activity, diet, and biological relatedness to other groups, past and present. Must hold graduate standing.

ANT 587/HI 587 Cultural Resource Management (3 credit hours)
Theoretical and practical overview of U.S. federal and state laws, institutions, and practices related to the inventory, evaluation, preservation, protection, and overall management of cultural resources; history and philosophical bases of Cultural Resource Management (CRM); professional ethics; indigenous and other stakeholder interests in CRM; and comparative national regulations outside the U.S. and the international heritage management and organizations. Graduate standing in history required.

Typically offered in Spring only

ANT 595 Special Topics in Anthropology (1-6 credit hours)
In depth exploration of specialized topics in Anthropology. Also used to test and develop new courses.

Prerequisite: Graduate Standing

ANT 598 Independent Study in ANT (1-3 credit hours)
Independent study of a topic in anthropology. Topic and mode of study determined by faculty member(s) and student(s).

Typically offered in Fall, Spring, and Summer

ANT 610 Special Topics in Anthropology (1-6 credit hours)
Provision for in-depth investigation of some particular topic in anthropology. Reflection of current student needs and interests through variations in course content and mode of study. Determination of topics by faculty member(s) and student.

ANT 693 Masters Supervised Research (1-9 credit hours)
Instruction in research, and research under the mentorship of a member of the Graduate Faculty. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 695 Masters Research (1-9 credit hours)
Thesis research conducted under the supervision of student's thesis committee chair or other graduate faculty member. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 696 Summer Thesis Res (1 credit hours)
Typically offered in Summer only

ANT 699 Masters Thesis Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, and other requirements for the masters degree, and are writing and defending their thesis. Restricted to Masters Students in Anthropology.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ANT 810 Special Topics in Anthropology (1-6 credit hours)
Provision for in-depth investigation of some particular topic in anthropology. Reflection of current student needs and interests through variations in course content and mode of study. Determination of topics by faculty member(s) and student.

Typically offered in Fall, Spring, and Summer

Applied Ecology (AEC)

AEC 114 Wicked Problems, Wolfpack Solutions: Global Change (2 credit hours)
Wicked Problems, Wolfpack Solutions is a shared academic experience designed for all students new to NC State. Each year, this course focuses on a current wicked problem, defined as a highly complex problem that can only be addressed through collaborative, multidisciplinary efforts. This course explores a wicked problem and possible solutions through the perspectives of NC State scholars representing many different areas of study and reflects NC State's commitment to inclusion of individuals and ideas from a broad diversity of backgrounds and experiences. AEC 114 focuses on the wicked problem of Global Change.

R: New First-Year Students and New Transfer Students
GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

AEC 203 An Introduction to the Honey Bee and Beekeeping (3 credit hours)
Introduction to honey bee biology and a fundamental understanding of beekeeping management including crop pollination by bees. Examination of the relationships between honey bees and humans from prehistoric through modern times and the behavior and social system of one of the animal world's most complex and highly organized non-human societies.

GEP Natural Sciences
Typically offered in Fall only

AEC 245 Global Conservation Ecology (3 credit hours)
This course provides an introduction to the scientific principles and concepts that are the foundation of conservation biology. A diversity of topics will be covered, including 1) causes of extinction, 2) the impacts of habitat fragmentation, small population sizes, and exotic species, 3) evidence based nature preserve and corridor design, and strategies for protecting and restoring endangered species and ecosystems. Students will build on their conceptual and analytical skills and gain real-world decision making through collaborative research projects, in which they will gather data and apply their findings to develop climate-smart conservation approaches.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

AEC 295 Special Topics in Applied Ecology (1-3 credit hours)
Special topics and experimental offerings in Applied Ecology including developmental courses offered on a trial basis. Intended for students at an intermediate level of training in Biological Sciences.

Prerequisite: BIO 181
Typically offered in Fall, Spring, and Summer

AEC 360/PB 360 Ecology (4 credit hours)
The science of ecology, including factors which control distribution and population dynamics of organisms, structure and function of biological communities, and energy flow and nutrient cycling in ecosystems; contrasts among the major biomes; and principles governing ecological responses to global climatic and other environmental changes.

Prerequisite: C- or better in BIO 181
Typically offered in Spring only

AEC 380 Water Resources: Global Issues in Ecology, Policy, Management, and Advocacy (3 credit hours)
This course will take a broad look at global issues associated with water resources, including the ways that people interact with water (how we use, degrade, conserve, and advocate for water and water rights). And how these interactions shape our lives. Woven throughout the course is the fact that science (ecology), policy (resource management), and cultural perspectives interact (sometimes in cooperation and sometimes in conflict) on many topics related to water. Students will explore water resource issues from the perspectives of ecology, natural resource management, and different cultures. The course is appropriate for students with interests in the life and social sciences.

Prerequisite: BIO 181
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

AEC 384 Tropical Ecology in a Changing World (3 credit hours)
The tropics have attracted the attention of scientist for a long time and tropical studies have help advance our understanding of ecology and ecological theories. This course will focus on understanding tropical ecosystems, their biodiversity, and complexity. Students will learn about major ecosystem types and their characteristics. We will discuss major tropical contributions to ecology and ecological theories. In addition, we will study how global change is affecting the tropics and the potential consequences. Students will gain a general understanding of tropical ecology in a changing world.

P: AEC 360 / PB 360 or equivalent
Typically offered in Spring only

AEC 390 Community Ecology (3 credit hours)
This course explores the various mechanisms structuring ecological communities. The course builds on community ecology topics introduced in other courses, by providing an advanced understanding of the theoretical and quantitative nature of community ecology. Topics covered include two-species interactions (e.g. predation, competition, parasitism, mutualisms), multispecies interactions, food webs and ecological networks, biodiversity and ecosystem functioning, estimation of and regulation of species diversity at ecological and evolutionary time scales, higher order interactions, community succession, and biogeography. Emphasis will be on concepts and theory, quantitative and mathematical models, experimental and other empirical approaches, and hands-on use of data and computer software to address basic and applied questions in community ecology.

Prerequisites: (ENV 101 or AEC 360 or PB 360 or FOR 260) and (MA 121 or MA 131 or MA 141 or ST 311)
Typically offered in Spring only

AEC 400 Applied Ecology (3 credit hours)
Global climate change, over-fishing, habitat loss, altered nutrient cycles, and the spread of invasive species are among the world's pressing global environmental issues. Solutions to these problems are complex, but firmly rooted in the fundamental tenets of ecological theory. The field of applied ecology is premised on using these fundamental ecological principles to help solve the environmental challenges we face. This course will provide an overview of the field of applied ecology, based on a series of case studies. Working from the individual to global level, the course will provide a broad perspective on the field of applied ecology.

Prerequisite: AEC/PB 360
Typically offered in Fall only

AEC 409/AEC 509 Ecology and Conservation of Freshwater Invertebrates (3 credit hours)
This course will introduce the student to the identification and ecology of freshwater invertebrates, with an emphasis on their life histories and adaptation to diverse freshwater habitats, significance to higher trophic levels, such as fish, ecosystem functioning, as a major source of freshwater animal diversity, conservation of threatened species, and application to bioassessment of water quality.

Typically offered in Spring only

AEC 419/AEC 519 Freshwater Ecology (4 credit hours)
The course explores the structure and function of streams, lakes, and wetlands, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on organisms and water quality. The laboratory emphasizes modern, hands-on techniques for answering fundamental and applied questions. One local weekend field trip required. Credit in both AEC 419 and AEC 519 is not allowed.

Prerequisite: C- or better in BIO/PB 360
Typically offered in Fall only

AEC 420 Introduction to Fisheries Science (3 credit hours)
Role of fish in aquatic ecosystems, fish biology, fish ecology, fisheries management and conservation. Emphasis on aquatic ecosystems and food webs, life history and ecology of important sport and commercial fishes, population and community dynamics, and theory and practice of fisheries management and conservation. Case studies from freshwater, estuarine and marine systems.

Prerequisite: C- or better in BIO/PB 360
Typically offered in Spring only

AEC 423 Introduction to Fisheries Sciences Laboratory (1 credit hours)
General anatomy and identification of common freshwater, estuarine and marine fish, functional morphology, age and growth analyses, fish health and diets. Computer analyses of bioenergetic and population dynamics.

Corequisite: FW/BIO 420
Typically offered in Spring only

AEC 424 Marine Fisheries Ecology (3 credit hours)
This course covers the life history, stock concept, fishing gears, stock assessment approaches, fish-habitat relationships, socio-economics, and management of marine fishes. Several field trips to state and federal agency laboratories and fish houses/docks are used to emphasize fish sampling, biological sample processing, and gear design. This course is part of the semester at CMAST program and requires students to be on site in Morehead City, NC.

Prerequisite: BIO 181
Typically offered in Spring only

AEC 441 Biology of Fishes (3 credit hours)
Behavior, evolution, physiology and ecology of fishes, emphasizing their adaptations for life in streams, lakes, and oceans.

Prerequisite: C- or better in BIO/PB 360 Corequisite: AEC 442 Biology of Fishes Laboratory
Typically offered in Fall only

AEC 442 Biology of Fishes Laboratory (1 credit hours)
Field and laboratory exercises with the common fish species and communities of North Carolina. Field trips to local streams and lakes plus weekend trips to coastal, estuarine, and mountain habitats.

Corequisite: AEC 441
Typically offered in Fall only

AEC 460 Field Ecology and Methods (4 credit hours)
Field Ecology and Methods will expose senior students with interests in Ecology and Evolution to the diverse field approaches used to address ecological questions. The course considers and implements a variety of field approaches ranging from microcosm experiments to global studies of patterns and diversity. Course is restricted to seniors.

Prerequisite: C- or better in ST 311 and BIO 360
Typically offered in Fall only

AEC 470/AEC 570 Urban Ecology (3 credit hours)
Developing design, conservation, and management strategies to serve humans and biodiversity in urban areas is an ongoing challenge. This course examines cities as unique physical environments and as social-ecological systems: How urban factors drive physiology, abundance and distribution of plants and animals, with consequences for biodiversity, ecosystem function, and human well-being. We will discuss the role of ecology in urban design and management, and emphasize the question of whether urban systems, and the role of humans therein, are adequately described by existing ecological principles.

P: AEC360 / PB360 or equivalent
Typically offered in Fall only

AEC 492 External Learning Experience in Applied Ecology (1-3 credit hours)
Learning experience in applied ecology within an academic framework with facilities and resources on or off campus. Contact and arrangements with prospective supervisors must be done by the student. Prior approval by faculty advisor and minor coordinator in department of applied ecology is required. Students are responsible for risk and safety assessment at off campus locations. Students are responsible for transportation. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: BIO 181 (Variable, depending on instructor)
Typically offered in Fall, Spring, and Summer

AEC 493 Internal Learning Experience in Applied Ecology (1-3 credit hours)
Internal learning experience in applied ecology within an academic framework with facilities and resources on campus. Contact and arrangements with prospective supervisors must be done by the student. Prior approval by faculty advisor and minor coordinator in department of applied ecology is required. Students are responsible for risk and safety assessment at off campus locations. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: BIO 181 (Variable, depending on instructor)
Typically offered in Fall and Spring

AEC 495 Advanced Special Topics in Applied Ecology (1-4 credit hours)
Special topics and experimental offerings in Applied Ecology including developmental courses offered on a trial basis. Intended for students at an advanced level of training in Biological Sciences.

Typically offered in Fall, Spring, and Summer

AEC 501 Ornithology (4 credit hours)
The biology of birds. Lecture topics include evolution, functional morphology, physiology, ecology and behavior. Field and museum laboratories emphasize particular aspects of morphology, ecology and behavior, as well as taxonomy and identification.One coastal weekend field trip required.

Prerequisite: BIO 181, BIO 183, and (BIO 250 or BIO/PB 360)
Typically offered in Fall only

AEC 502 Introduction to Biological Research (2 credit hours)
The main objectives of this course are to introduce and develop the tools and skills useful for excelling in graduate programs in Biology. Topics range from practical skills, such as selecting a committee, communication, data management, generating a thesis topic, and formulating hypotheses, to those that are more philosophical. There is a focus on scientific writing, especially grant proposals, and other professional skills, such as oral discussions of topics related to diversity and inclusivity, collaboration, publishing and reviewing, and developing professional skills and relationships that will be important throughout the graduate tenure of the students.

Typically offered in Fall only

AEC 503 Foundations of Ecology (2 credit hours)
This course covers major concepts, themes, and theories in ecology, including population, community and ecosystem ecology, and evolutionary ecology. Students are introduced to the core skill of critically evaluating scientific papers. The format of the course is readings from the primary literature and student-lead discussions. This course is focused toward first- and second-year graduate students, especially those in preparation for their preliminary exam.

Prerequisite: Graduate standing
Typically offered in Spring only

AEC 509/AEC 409 Ecology and Conservation of Freshwater Invertebrates (3 credit hours)
This course will introduce the student to the identification and ecology of freshwater invertebrates, with an emphasis on their life histories and adaptation to diverse freshwater habitats, significance to higher trophic levels, such as fish, ecosystem functioning, as a major source of freshwater animal diversity, conservation of threatened species, and application to bioassessment of water quality.

Typically offered in Spring only

AEC 510 Machine Learning Approaches in Biological Sciences (2 credit hours)
A wide range of high-throughput technologies are now being used to generate data to answer an ever-increasingly diverse set of questions about biological systems. The next great challenge is integrating data analysis in a systems biology approach that utilizes novel supervised machine learning methods, which accommodate heterogeneity of data, are robust to biological variation, and provide mechanistic insight. The course will not focus on detailed mathematical models, but instead on how these machine learning tools may be used to analyze biological data, in particular gene and protein expression.

Restriction: Graduate standing; Senior Undergraduates with permission from instructor
Typically offered in Fall only

AEC 515/FW 515 Fish Physiology (3 credit hours)
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.

Typically offered in Fall only

AEC 519/AEC 419 Freshwater Ecology (4 credit hours)
The course explores the structure and function of streams, lakes, and wetlands, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on organisms and water quality. The laboratory emphasizes modern, hands-on techniques for answering fundamental and applied questions. One local weekend field trip required. Credit in both AEC 419 and AEC 519 is not allowed.

Prerequisite: C- or better in BIO/PB 360
Typically offered in Fall only

AEC 570/AEC 470 Urban Ecology (3 credit hours)
Developing design, conservation, and management strategies to serve humans and biodiversity in urban areas is an ongoing challenge. This course examines cities as unique physical environments and as social-ecological systems: How urban factors drive physiology, abundance and distribution of plants and animals, with consequences for biodiversity, ecosystem function, and human well-being. We will discuss the role of ecology in urban design and management, and emphasize the question of whether urban systems, and the role of humans therein, are adequately described by existing ecological principles.

P: AEC360 / PB360 or equivalent
Typically offered in Fall only

AEC 586/FW 586 Aquaculture (3 credit hours)
Biological and general principles of aquaculture. Emphasis on the present status of aquaculture, species involved, techniques employed, and problems encountered. Discussion of recent advances in research and development and identification of areas of future research and development.

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing
Typically offered in Spring only

AEC 587/FW 587 Aquaculture Laboratory (1 credit hours)
Methods and techniques of cultivating aquatic organisms. Field trips and reports on local hatcheries and facilities required. (Three to four overnight field trips taken on week days to coastal areas, state hatcheries, and private hatcheries; students responsible for shared room costs and their meals. Four field trips also taken on laboratory day within driving range of Raleigh.)

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing, Corequisite: ZO 586
Typically offered in Spring only

AEC 592 Special Topics in Applied Ecology (1-6 credit hours)
Special Topics in Applied Ecology. Topics will vary.

Typically offered in Fall, Spring, and Summer

AEC 624 Advanced Fisheries Science (2 credit hours)
This is a seminar style course where students and faculty discuss readings in advanced fisheries science. The course is offered to students at CMAST (live) and on main campus (using Zoom or related online meeting software). Transportation is not required.

Typically offered in Fall only

AEC 630 Special Topics in AEC (1-6 credit hours)
Special Topics in AEC

Typically offered in Fall, Spring, and Summer

AEC 710 Sampling Animal Populations (3 credit hours)
Statistical methods applicable to sampling of wildlife populations, including capture-recapture, removal, change in ratio, quadrant and line transect sampling. Emphasis on model assumptions and study design.

Prerequisite: ST 512
Typically offered in Fall only

AEC 718 Community Ecology (3 credit hours)
Animal community structure and function. Effects of competition, predation, coevolution and disturbance on community composition. Emphasis on ecological and evolutionary controversies from empirical and theoretical approaches.

Prerequisite: BO 360 or ZO 260, BO(ZO) 760; BO(ZO) 365
Typically offered in Spring only

AEC 726/FW 726 Quantitative Fisheries Management (3 credit hours)
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.

Typically offered in Fall only

AEC 756 Ecology Of Fishes (3 credit hours)
Physiological ecology of fishes emphasizing energetics, production and adaptations to aquatic mediums. Ecological classification of fishes and theory of resource partitioning in freshwater, estuarine and marine realms.

Typically offered in Fall only

AEC 761 Conservation and Climate Science (3 credit hours)
Conservation Science applies principles from ecology, genetics, and other biological disciplines and social sciences to the conservation of biological diversity. This course will train students in techniques in population ecology such as population viability analysis; community ecology and theories of biodiversity; and reserve selection algorithms. The course will also expose and trains students to understand climate science and using climate data for ecological studies. The class will examine threats to biodiversity such as habitat fragmentation and loss, climate change, and invasion by exotic species. These issues will be considered within the context of economic, social, and legal constraints. Graduate status or permission of instructor.

Typically offered in Fall only

AEC 770 Advanced Topics In Ecology I (3 credit hours)
Development of subject matter in major fields of ecology through seminars and lectures and principles illustrated by laboratory exercises and field trips. Microenvironment, population biology, community ecology, ecosystems and nutrient cycling.

Typically offered in Spring only

Architecture (ARC)

ARC 140 Experiencing Architecture (3 credit hours)
An introductory course intended to provide non-majors with a foundation in the basic concepts of architecture. Provides a general understanding of contemporary issues and theory in architecture, concerns about green architecture and sustainability, architecture practice and the role architecture plays in the design of cities.

GEP Visual and Performing Arts
Typically offered in Spring and Summer

ARC 141 Introduction to Architectural History (3 credit hours)
World architectural history of sacred and secular buildings and buildings with emphasis before the modern era. For non-Architecture majors only. Does not count toward Architecture degrees.

R: For non-Architecture majors only.
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARC 162 An Introduction to Architecture (3 credit hours)
The purpose of architecture examined through its practices, theories and key principles. Lectures, projects, and readings expose students to the diverse world of ideas, creative work and practical considerations which make up the discipline of architecture.

Prerequisite: D 104 and BED-A students; Corequisite: D 105
Typically offered in Spring only

ARC 201 Architectural Design: Environment (6 credit hours)
Investigation of the relationships between environment and built form. Solar orientation, topography, vegetation, and constructed context in relationship to user needs as parameters for justifying design proposals. Particular emphasis on architectural conventions of communication.

Prerequisite: D 105; BED-A students only; Corequisite: ARC 211
Typically offered in Fall only

ARC 202 Architectural Design: Form (6 credit hours)
Investigation of relationships between idea and form. Composition and precedent as parameters for generating, developing, and justifying architectural form. Particular emphasis on electronic media in drawing and modeling.

Prerequisite: ARC 201 and BED-A students
Typically offered in Spring only

ARC 211 Natural Systems and Architecture (3 credit hours)
Restricted to students in BEDA Program. Relationship between natural and architectural systems. Exploration of the implications of natural forces - sun, wind and daylight- on architecture. Energy-conscious architectural design and site planning strategies to fulfill thermal comfort requirements of people in designed environments.

Prerequisite: D 105
Typically offered in Fall only

ARC 232 Structures and Materials (3 credit hours)
An introduction to construction materials and building structures. Explorations of materials' properties, aesthetics, environmental impact, and performance. Quantitative and qualitative analysis of structural building elements. Course integrates lecture and laboratory. Off-campus field trips are included (students may need to coordinate transportation).

Typically offered in Spring only

ARC 241 History of World Architecture (3 credit hours)
History of the built environment (buildings, urban planning, and associated arts) in western and non-western cultures, ranging from dawn of civilization to dawn of modern era, including high-style architecture, vernacular buildings, and traditional forms.

Typically offered in Fall only

ARC 242 History of Western Architecture (3 credit hours)
History of western architecture (including some landscape architecture and city planning) from the beginnings of the Renaissance in early 15th century to late 19th century in the United States.

Prerequisite: ARC 241 or Consent of Instructor
Typically offered in Spring only

ARC 250 Fundamentals of Architectural Visualization (3 credit hours)
Drawing is a skill fundamental to the discipline of architecture. Drawing allows us to record the world around us. In doing so, we learn and observe the built environment and invigorate our observation skills, an ability essential to architects. Drawing enables us to visualize imaged environments. Drawings allow us to communicate our ideas with others, and most importantly, with ourselves. This dialogue, namely visual thinking, enables us to transform the initial blurry images of imagined environments into defined (and refined) ideas. This course will introduce drawing skills, techniques, and concepts necessary to visualize and understand architectural design ideas.

Prerequisite: Architecture Majors Only
Typically offered in Fall only

ARC 251 Digital Representation (3 credit hours)
Project based methodological investigation of digital representation in architecture including: two- three- and four-dimensional media. Purchase of laptop and necessary software required.

Prerequisite: BED-A students or Master of Arch, Track 3 students
Typically offered in Spring only

ARC 289 Architectural Travel Study I (3 credit hours)
The study of cities, architectural sites, buildings, building complexes, and architectural elements conducted independently by students as part of a planned travel-study tour. Includes advance research and approval of proposed study topic and itinerary. Students will document study through sketches, analytical notations, and a summary paper. Departmental Approval Required

Prerequisite: ARC 141 and ARC 142
Typically offered in Fall and Spring

ARC 292 Special Topics in Architecture (1-3 credit hours)
Topics of current interest in Architecture. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

ARC 301 Architectural Design: Tectonics (6 credit hours)
An introduction to the fundamentals of building systems on architectural design. Emphases on building assemblages, vertical-load structural systems, circulation, and passive heating, cooling, and ventilation. Particular emphasis on physical models. Limited to BED-A Students. Junior Standing. Students are required to purchase project materials.

Prerequisite: ARC 202 and ARC 211 and ARC 232; Corequisite: ARC 331 and ARC 432
Typically offered in Fall only

ARC 302 Architectural Design: Technology (6 credit hours)
An investigation of building technical systems as fundamental elements of the design process with emphasis on lateral load resisting structural strategies, environmental control/energy, enclosure assembly detail, and their architectural implications. Particular emphasis on physical models. Restricted to BED-A students, Junior standing. Students are required to purchase materials for projects.

Prerequisite: ARC 301 and ARC 331 and ARC 432
Typically offered in Spring only

ARC 331 Architectural Structures I (3 credit hours)
Structural design process. Combined role of imposed loads and architectural function in shaping the form of the building. Interaction of elements in structural systems containing beams, columns, trusses, space frames, slabs, arches, vaults, domes,cables, cable networks, fabrics and diaphrams. Case studies emphasized.

Prerequisite: ARC 232
Typically offered in Fall only

ARC 332 Architectural Structures II (3 credit hours)
Structural systems explored through case studies and design projects. Emphasis on interaction of structural elements. Tracing of loads in structural systems. Sizing of tensile elements, columns, trusses, and flexural elements. Design and sizing of joints.

Prerequisite: ARC 331
Typically offered in Spring only

ARC 401 Architectural Design: Urban (6 credit hours)
An architectural design studio intended to explore and integrate design issues of all types within an urban environment. Emphasis will be placed on both formal and technical issues of urban sites including transportation and land use planning, phasing of projects over time, relationships to other structures, and the application of development codes, regulations, and urban design principles to the fabric of the city.

Prerequisite: ARC 302 and BED-A student
Typically offered in Fall only

ARC 402 Architectural Design: Advanced (6 credit hours)
Advanced architectural design studios in which projects of many types and scales are employed to investigate a range of educational, theoretical and professional studies. Particular emphasis on independent research and exploration of design issues and their implications as defined by faculty.

Prerequisite: ARC 401 and BED-A students
Typically offered in Spring and Summer

ARC 403 Architectural Design Fundamentals: Environment (6 credit hours)
An introductory architectural design studio for M. Arch, Track 3 students investigating the relationship between environment and built form. Solar orientation, climate, topography, vegetation, and constructed context in relationship to user needs as parameters for design proposals. Particular emphasis on design fundamentals and conventions of architectural communication.

Prerequisite: Masters of Architecture students; Co-requisite: ARC 211
Typically offered in Fall only

ARC 404 Architectural Design Fundamentals: Form (6 credit hours)
An introductory architectural design studio for M. Arch. Track 3 students investigating relationships between idea and form. Composition and precedent as parameters for generating, developing, and justifying architectural form. Particular emphasison electronic media in drawing and modeling.

Prerequisite: Masters of Architecture Track 3 students; ARC 403; Co-requisite: ARC 251
Typically offered in Spring only

ARC 405 Architectural Design Fundamentals: Technology (6 credit hours)
An introductory architectural design studio for M. Arch. Track 3 students in which the technical systems of building - structure, environmental control/energy, materials, enclosure, and circulation; their fabrication and assembly; and their capacityto affect form and tectonic expression - are explored as fundamental elements of the design process. Particular emphasis on physical models.

Prerequisite: Master of Architecture students; ARC 404; Co-requisite: ARC 331 and ARC 432
Typically offered in Fall only

ARC 414 Environmental Control Systems (3 credit hours)
Studies in light, heat, moisture, air motion, and sound in architectural environments. Mechanical, electrical and/or electronic equipment for illumination, heating, cooling, ventilation, vertical transportation and communication in buildings. Water and waste, fire protection and safety, and acoustic systems in architecture.

Prerequisite: ARC 211
Typically offered in Spring only

ARC 432 Architectural Construction Systems (3 credit hours)
Building construction systems related to architectural design. Historical and current building practices. Implications for design and systems selection. Case studies. Field trips are required.

Prerequisite: ARC 232
Typically offered in Fall only

ARC 441 History of Contemporary Architecture (3 credit hours)
A survey and critical examination of modern architecture from its origins in 19th-century philosophy and technology to the most recent developments in world architecture.

Prerequisite: ARC 241, ARC 242; BED-A students, Bachelor of Architecture students, or Masters of Architecture students
Typically offered in Fall only

ARC 442 History of NC Architecture (3 credit hours)
Survey of NC Architecture from 17th-century settlement to World War II. Coverage of a wide range of building types and development patterns.

Prerequisite: ARC 241, ARC 242

ARC 450 Architectural Drawing (3 credit hours)
Introduction to hand drawing skills, techniques, and concepts necessary to use drawing for visual thinking (and visual communication) particularly in the development of design ideas and understanding of architecture. Restricted to Masters of Architecture Track III students.

Corequisite: ARC 451
Typically offered in Summer only

ARC 451 Digital Drawing and Modeling (3 credit hours)
Introductory course to digital communication tools as an integral part of the architectural design process. This course challenges students to develop diverse two and three-dimensional drawing and modeling skills through project-based exercises that engage various digital visualization and layout software. Purchase of laptop and necessary software required. Summer 5 week course. Restricted to Master of Architecture, Track III students.

Co-requisite: ARC 450
Typically offered in Spring only

ARC 490 Architecture International Studio (6 credit hours)
Exploration of architectural problems and development of design solutions in an international setting. Studio projects focused on current conditions found in the host culture, profession, and community.

Prerequisite: ARC 302, Participation in off-campus program.
Typically offered in Fall only

ARC 492 Special Topics in Architecture (1-3 credit hours)
Topics of current interest in Architecture. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

ARC 495 Independent Study in Architecture (1-3 credit hours)
Special projects in architecture developed under the direction of a faculty member on a tutorial basis. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: BED-A students with Junior standing and a GPA greater than or equal to 3.0.
Typically offered in Fall, Spring, and Summer

ARC 500 Architectural Design: Professional Studio (6 credit hours)
A comprehensive and integrative architectural design studio for M.Arch students involving the execution of a project in sufficient depth to understand the opportunities and discipline resulting from the inclusion of building.

Prerequisite: M.Arch Track 1 and Track 3 student, ARC 405 or BEDA Degree (or equivalent)
Typically offered in Fall and Spring

ARC 501 Professional Architecture Studio I (6 credit hours)
Design studio investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design.

Prerequisite: BEDA degree
Typically offered in Fall only

ARC 502 Professional Architecture Studio II (6 credit hours)
Design investigation aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design. This is an individualized, final project studio.

Prerequisite: ARC 501
Typically offered in Spring only

ARC 503 Advanced Architectural Design (Series) (6 credit hours)
Advanced studies in architectural design. Projects concerning various aspects of building design, urban design and community design in comprehensive and integrative manner.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ARC 520 Sustainable Architecture (3 credit hours)
This survey course provides students with a solid knowledge base in the numerous aspects of sustainable design touching not only upon strategies, but also various philosophies behind sustainability and the green building movement. This course examines the impact of the built environment on natural systems and questions what it truly means to build responsibly. Lectures, discussions, guest speakers, and field trips create a critical foundation for green building considerations to be references in design at a variety of scales. Restricted to M. Arch, B. Arch, and BEDA seniors. Non-architecture majors by instructor's permission.

Architecture or Environmental Design in Architecture Majors Only
Typically offered in Summer only

ARC 521 Daylighting and Passive Energy Systems for Architecture (3 credit hours)
An investigation of building energy systems and simulation techniques with emphases on thermal envelope, solar geometry, daylighting, passive heating & cooling, and building systems integration. The theoretical considerations will be accompanied by hands-on exercises using various simulation tools. Restricted to M.Arch, B.Arch, and BEDA Senior Students. Non-Architecture majors by instructor's permission.

Typically offered in Fall only

ARC 522 Building Energy Efficiency & Renewable Energy (3 credit hours)
This course will discuss and develop strategies for the design of sustainable buildings. The two primary topics addressed are: 1) energy efficiency and 2) renewable energy. The students will learn and discuss ways to improve energy efficiency in buildings. The renewable energy technologies, such as solar and geothermal, are explored to discuss the applicability of those in the building design.

Typically offered in Fall only

ARC 523 Building Energy Modeling and Simulation (3 credit hours)
This course deals with the fundamentals of building sciences in terms of energy systems. Energy modeling and simulation technologies are used to predict and analyze the energy performance of buildings. The students calculate the energy consumption of heating, cooling, lighting, and equipment by hand to understand the energy & thermal behavior of buildings and then compare and analyze them with those calculated by energy modeling and simulation programs.

Prerequisite: ARC 414
Typically offered in Fall only

ARC 524 Building Energy Optimization (3 credit hours)
This course introduces energy optimization technologies in buildings using computer simulation. The EnergyPlus program, a whole-building computational energy simulation tool developed by USDOE, is used. The maximum energy savings potential of Energy Efficience Measures (EEMs) are identified and implemented for the energy optimization process. Students obtain a great deal of information about a building's potential for energy savings, well before the first brick is even laid.

Prerequisite: ARC 523
Typically offered in Spring only

ARC 525 Sustainability Over the Life of a Building (3 credit hours)
Focuses on strategies and metrics for "greening" existing buildings. Sustainability over the Life of a Building will explore the criteria and documentation needed to certify a building at NC State in the LEED for Existing Buildings: Operations and Maintenance (EBOM) rating system. This course will emphasize the importance of interdisciplinary work while working toward sustainability goals. Over the course of the semester, students will research various criteria and thresholds for the LEED EBOM system. Through this in-depth process, students will synthesize core knowledge about LEED credits to better understand opportunities for strategies in green buildings. Over the course of the semester, students will research various criteria in-depth which are needed for LEED Existing Building Certification, not only becoming familiar with the rating system itself, but also the foundation for each of the addressed LEED credits, as well as context for decisions made in the realm of green buildings.

This is a graduate-level seminar open to all NCSU master's degree students but can be open to advanced standing undergraduate students with instructors' approval. No prerequisites.
Typically offered in Fall only

ARC 526 Health and Sustainability in the Built Environment (3 credit hours)
Explores opportunities in the design and aligned fields for facilitating higher sustainability and health targets, associated thresholds, and certification achievements in the built environment. Building rating systems are reviewed that address categories such as social equity, carbon neutrality, material toxicity, nourishment, fitness, mind, justness, and more. Reaching beyond the standards of current green building practice and public policy, the class will explore methods and case studies using cutting-edge building certification frameworks to target carbon neutral, net-zero, and health-promotive design. Student teams will be working on specific projects with professional firms for their final projects.

This is a graduate-level seminar open to all NCSU master's degree students but can be open to advanced standing undergraduate students with instructors' approval. No prerequisites.
Typically offered in Spring only

ARC 530 Tectonics and Craft (3 credit hours)
Studies of construction and material form in architecture. Case studies of select examples of contemporary architecture that exemplify the technique and craft of modern construction. Analysis of functional, tectonic, and experiential aspects of building methods within the context of economics and culture. Examination of assembly as a determinant of building form.

Prerequisite: Architecture Majors, ARC 432
Typically offered in Fall only

ARC 534 Design of Architectural Details (3 credit hours)
Using detail patterns based on function, constructability, and aesthetics, students analyze existing successful building details, diagnose problems in existing buildings, and design details for their own projects. Restricted to Bachelors and Masters students in Architecture.

Typically offered in Spring only

ARC 535 Experiments in Architecture Prototypes (3 credit hours)
Examination of significant architecture prototypes of the Modern Movement. Seminar will investigate the effectiveness of prototypes in proposing solutions to technological, social, and environmental issues such as housing, education, and sustainability. Students will explore the possibilities of prototype design and construction in contemporary practice. Field trips required.

Prerequisite:ARC 232 or equivalent
Typically offered in Summer only

ARC 536 Materials for Design (3 credit hours)
Contemporary buildings that have insightfully integrated design intention and materials are analyzed using the case study method. Each student uses an iterative analytical process to probe deeply and specifically to find each building's key lessons regarding materials. Key drawings and photographs will be graphically presented, with a narrative summarizing findings regarding the project's general design intentions and its technical embodiment. Restricted to M. Arch or B. Arch Students.

P:
Typically offered in Fall only

ARC 537 Digital Materials Translations (3 credit hours)
This seminar combines architectural material research with instruction in advanced digital design software. Students will examine specific materials to determine attributes, and then use parametric, NURBS-based software, and CNC machinery to propose new material applications. The course is limited to College of Design students unless instructors grant permission.

Prerequisite: (ARC 251 or ARC 451 or equivalent) and (ARC 232 or equivalent)
Typically offered in Fall only

ARC 538 Manufacturing Architecture (3 credit hours)
Focuses on customized repetitive manufacturing for architecture components. Specifically includes repetitive processes that make repeated uses of tooling (e.g. molds, patterns, or jigs) to form components. We will investigate repetitive manufacturing processes and architectural case studies. Limited to MArch, BArch, and BED-A students, senior standing.

Prerequisite: Architecture Majors, ARC 432
Typically offered in Fall only

ARC 540 Architectural Theory (3 credit hours)
This course provides an introduction to the major themes and associated figures of architectural theory. It focuses on 20th and 21st century texts with a particular emphasis on historicism, phenomenology, structuralism and post-structuralism. Each week there is assigned reading from a range of texts, including extra-disciplinary writers. Lectures and discussions serve to identify principal themes, connect to contemporary issues, and establish relevancy to architectural design. Restricted to M. Arch, B. Arch, and BEDA Seniors. Non-architecture majors by instructor's permission.

Typically offered in Spring only

ARC 541 Architecture, Culture, and Meaning (3 credit hours)
This course focuses on architecture as a cultural artifact and provides an overview of the interrelationship of architectural form, organization, symbolism, use and meaning. A broad range of examples from a variety of cultures, religions, and historical periods are covered (including "non-Western"), illustrated by detailed case studies. Syncretic, holistic and homological approaches to understanding the meaning and significance of architecture are emphasized. Phenomenological and hermeneutical methods of interpretation are introduced and pertinent philosophical traditions discussed. Restricted to M.Arch., B.Arch., and BEDA seniors. Non-architecture majors by instructor's permission.

Typically offered in Fall only

ARC 542 Sacred Architecture (3 credit hours)
This course focuses on the meaning and cultural significance of sacred architecture, including its environmental and socio-political contexts, and doctrinal and liturgical influences. The course is structured according to the world's principal faiths and presented comparatively and holistically. There is a particular emphasis on the communicative roles of architecture and the symbolism and ritual use of sacred places. Contemporary theoretical methodologies are introduced and applied as means establish relevancy to contemporary issues and architectural design. Restricted to graduate students.

Typically offered in Fall only

ARC 543 Analysis of Precedent (3 credit hours)
Investigation of architectural elements, relationships and ordering ideas through comparative graphic analysis of buildings designed by architects. Emphasis on buildings as physical artifacts.

Prerequisite: Grad. standing
Typically offered in Spring only

ARC 544 American City Planning History (3 credit hours)
An examination of the history of American cities, their founding, plans, and development with emphasis on the colonial era to the late 19th century. Broad study of the larger historical trends in city planning balanced by readings focused on major cities (New York, Chicago, Los Angeles) and smaller ones (Savannah, New Orleans). Major issues include street patterns, parks,and public buildings and spaces; and the roles of government and private citizen groups. Restricted to graduate students in the MArch, seniors in the BArch, and seniors in the BEDA programs; or by permission of theinstructor.

Prerequisite: ARC 241 and ARC 242 and ARC 441 or permission of instructor.
Typically offered in Spring only

ARC 545 Methods of Interpretation in Architectural History (3 credit hours)
This seminar surveys the materials, methods, and texts of architectural history as an analytical discipline of the built environment. A broad selection of readings will trace the evolution of the discipline and will position architectural history in relation to such fields as architecture, art history, urban and social history, anthropology, literature, cultural studies, urban planning, and architectural theory. The course is restricted to graduate students and serves as one of the alternate required courses for the Concentration in the History and Theory of Architecture.

P: ARC 241 and ARC 242 and ARC
Typically offered in Fall only

ARC 546 Theory of Building Types (3 credit hours)
Theoretical implications and practical applications of typology in architecture. Analysis and documentation of selected building types in their historical evolution. Graphic identification of type characteristics.

Prerequisite: Two ARC studios
Typically offered in Fall only

ARC 548 Vernacular Architecture (3 credit hours)
Readings in theories of vernacular architecture. Case studies of selected examples of vernacular architecture of the world: architectural analysis of utilitarian, tectonic, and perceptual aspects of buildings and urban fabrics against the background of place and culture. Examination of influences of various vernacular traditions on contemporary practice.

Prerequisite: M.Arch student without an undergraduate degree in architecture must have completed ARC 211,ARC 241,ARC 232
Typically offered in Spring only

ARC 561 The Practice of Architecture (3 credit hours)
A lecture course examination of the practice of architecture through a lecture course, with emphasis upon both normative and emerging procedures in the private architectural firm. Special attention upon the role and function of the practicing architect, legal and regulatory conditions, the nature of professional services, office management and project management processes.

Typically offered in Fall and Spring

ARC 562 Legal Issues in Architecture (3 credit hours)
The main principles of law affecting the profession of architecture as it is influenced by contracts, torts, agency, property, and environmental restrictions.

Prerequisite: Architecture Majors, ARC 561
Typically offered in Fall only

ARC 563 Public Interest Design Seminar: Case Studies and Current Issues (3 credit hours)
This course evaluates and appraises design in the public interest as a critical and growing element of design disciplines. We explore how design can positively contribute to the social, economic, and environmental well-being of US and global communities. We study current innovations and review successful examples of projects and practice. In addition to lectures by the professor, presentations are made by professionals and experts in public interest design.

The class is open to Architecture Graduate Students in the College of Design. Other NCSU students may enroll by permission of Instructor.
Typically offered in Spring only

ARC 570 Anatomy of the City (3 credit hours)
A morphological investigation of cities throughout urban history, with emphasis on formal principles of spatial organization. Part one: examination of the descriptive properties of cities in terms of interdisciplinary concepts and principles. Part two: examination of the organizational characteristics of urban space.

Typically offered in Fall only

ARC 571 Urban House (3 credit hours)
This seminar is intended to investigate the interrelationships between the form of housing and the demands of a rapidly changing society. Reference is made to the physical, economic, social, cultural, and economic factors that influence housing design.

Prerequisite: Graduate standing
Typically offered in Spring only

ARC 572 Regional Infrastructures (3 credit hours)
This seminar provides students with a solid knowledge base about current urban issues and design theory surrounding the contemporary networked metropolis. Through lectures, discussions, and workshops the course examines how infrastructural systems might be expanded in order to catalyze additional environmental, social, and economic processes. Students research specific infrastructural systems (conducting food, water, or energy) at a systems-defined regional scale to better understand the characteristics of 21st century American cities and speculate on new opportunities for architects and landscape architects to practice. Restricted to M. Arch, B. Arch, BEDA seniors, and M. LArch.

Restricted to: M. Arch, B. Arch, BEDA seniors, and M. LArch
Typically offered in Spring only

ARC 574 Place and Place Making (3 credit hours)
Examination of the definitions, concepts and emergent research findings useful in explaining the human sense of place through seminar-lecture course. Particular emphasis upon those physical aspects and relationships influencing this sense of place and affording some designer control.

Prerequisite: Graduate standing
Typically offered in Fall only

ARC 576 Community Design (3 credit hours)
Processes through which citizens shape and manage built environment. Strategic planning, visioning process, community action, and mediation will be discussed and illustrated with case study examples from architecture, landscape architecture and planning. Analysis and assessment from case studies of participation techniques such as charrette, study circles, and visual appraisal.

Typically offered in Fall only

ARC 577 Sustainable Communities (3 credit hours)
Historical precedents of sustainable communities. Examination of the Garden City, the New Towns Movement, and the New Urbanism. Comparison of sustainable communities to urban visions of Wright, Corbusier, Soleri and others. Virtual cities and digital communities.

Typically offered in Spring only

ARC 581 Project Preparation Seminar (3 credit hours)
Quantitative and qualitative conditions, considerations and determinants as preparation for architectural design. Emphasis on research methods, data collection and interpretation, theoretical discourse, site analysis, programming and architectural precedent. Required enrollment in B.Arch.

Typically offered in Fall only

ARC 589 Architectural Travel Study II (3 credit hours)
Independent study while traveling. Submission of sketchbook/journal and paper upon return. Research on topic of concentration and approval of itinerary in advance required. Graphic documentation and critical evaluation of buildings and urban spaces.Required of all participants in Dept. of Architecture Foreign Exchange and Summer Abroad Programs. Restricted to departmental approval.

Typically offered in Fall, Spring, and Summer

ARC 590 Special Topics in Architecture (1-6 credit hours)
Topics of current interest by faculty in the Department of Architecture. Subjects under this number normally to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ARC 598 Final Project Studio In Architecture (6 credit hours)
Final project for graduate students supervised by members of their graduate advisory committee. Requires department approval.

Prerequisite: 18 hrs. of ARC 503 and ARC 697
Typically offered in Fall and Spring

ARC 610 Special Topics in Architecture (1-6 credit hours)
Special Topics in Architecture

ARC 630 Independent Study (1-3 credit hours)
Development of research and projects in various aspects of architecture under the direction of architecture faculty member on tutorial basis. Requires a faculty sponsor and departmental approval.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ARC 682 Directed Research (3 credit hours)
Students work directly with their advisor in areas of research as defined by advisor. Includes research methods. Restricted to students enrolled in the Master of Advanced Architectural Studies program.

Restricted to students enrolled in the Master of Advanced Architectural Studies program.
Typically offered in Fall, Spring, and Summer

ARC 685 Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

ARC 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

ARC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

ARC 696 Summer Thesis Res (1 credit hours)

ARC 697 Final Project Research in Architecture (1-6 credit hours)
Investigation of selected problems and projects in architecture of particular interest to graduate students under the direction of a faculty member on a tutorial basis. Credits and content vary to meet the scope of the project proposal.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ARC 698 Advanced Architectural Studies Project (3-9 credit hours)
Investigation of specific topic and subjects, as defined by student in consultation with student's advisor, and approved and supervised by advisor. Includes research methods. Restricted to students enrolled in the Master of Advanced Architectural Studies program.

Restricted to students enrolled in the Master of Advanced Architectural Studies program.
Typically offered in Fall, Spring, and Summer

ARC 896 Summer Dissert Res (1 credit hours)

Art and Design (ADN)

ADN 111 Introduction to Two-Dimensional Design (3 credit hours)
An introduction to the fundamentals of design studies through two dimensional problems. The basic elements and concepts of design explored as abstract and applied problems through design issues. Provides non-design students an introduction to design principles and a language of design.

Typically offered in Fall, Spring, and Summer

ADN 112 Introduction to Three-Dimensional Design (3 credit hours)
An introduction to the fundamentals of design studies through three-dimensional problems. The basic elements and concepts of design explored as abstract and applied problems through the design issue. Provides non-design students a working knowledge of design principles and a language of design.

Typically offered in Fall and Spring

ADN 200/DS 200 A Survey of Design Studies (3 credit hours)
This course will introduce students to a variety of perspectives and lenses through which to examine and evaluate design in the world. Students will consider design studies through theory and criticism of design, as well as applied to business administration, museum studies, and environmental studies. In addition, students will be encouraged to find evidence of and define design studies in areas that are uniquely suited to their individual areas of interest. As an advised elective, this course is required for Design Studies majors who are sophomores in their major.

Typically offered in Fall only

ADN 202 Design Studio: Art & Design in Context (6 credit hours)
Emphasis on fundamental Art & Design visual language through investigative problem solving.

Prerequisite: D 104, D 105, or permission of department, ADN majors only
Typically offered in Spring only

ADN 203 Art + Design Sophomore Studio II (3 credit hours)
The Art + Design Sophomore Studio series includes four required courses of three-credit hours each to be completed in the sophomore year. ADN 202 and ADN 203 are offered in the fall semester. ADN 204 and ADN 205 are offered in the spring semester. The Art + Design Sophomore Studio Series focuses on the creative disciplines foundations taught at the intermediate and advance level Art + Design electives and studios. The Sophomore Studio Series courses include: Visual Composition (ADN 202); Sequential Imaging (ADN 203); Applied Creative Processes (ADN 204); and Interactive Media (ADN 205).

Prerequisite: ADN 201, or permission of department, ADN majors only
Typically offered in Fall only

ADN 204 Art + Design Sophomore Studio Spring (6 credit hours)
The Art + Design Sophomore Studio series includes two required courses of six-credit hours each to be completed in the sophomore year. ADN 202 is offered in the fall semester. ADN 204 is offered in the spring semester. The Art + Design Sophomore Studio Series focuses on the creative disciplines foundations taught at the intermediate and advance level Art + Design electives and studios.

Typically offered in Spring only

ADN 212 Photography I (3 credit hours)
Introduction to the processes and visual skills necessary for the beginning photographer. Darkroom experimentation, pinhole camera, basic rudiments of camera use, film development and printing. Exploration of issues related to the quality of visual communication.

Typically offered in Fall and Spring

ADN 219 Digital Imaging I (3 credit hours)
Introduction to exploring, creating, and modifying images through the use of computers. Emphasis is on creativity, experimentation, and intuitive image-making using various computer techniques.

Prerequisite: D104 or ADN 111
Typically offered in Fall, Spring, and Summer

ADN 220 Digital Illustration I (3 credit hours)
Hands-on exploration of digital drawing, painting, and image editing techniques with the use of pressure sensitive digital drawing tablets and image editing software; Development of ability to design and communicate convincing 3-dimensional forms and environments using 2D digital techniques with an emphasis on gesture, shape, volume, intuitive perspective, color, and light; Application of design process and research to generate images for visual concept development; Examination of relationships between historic and contemporary conventions for traditional and digital image-making.

Typically offered in Fall and Spring

ADN 221 Digital Illustration II (3 credit hours)
Hands-on exploration of digital drawings, painting, and image editing techniques with the use of pressure sensitive digital drawing tablets and image editing software; Development of ability to integrate multiple visual elements to illustrate narratives and create illusionistic environments. Emphasis shot design, linear perspective, light, color, texture, and atmosphere; Application of design process and research to generate images for visual concept development and mood; Examination of relationship between historic and contemporary illustration, compositing, and matte painting techniques.

Prerequisite: ADN 220
Typically offered in Fall and Spring

ADN 224 Digital Motion (3 credit hours)
Hands-on exploration of motion, animation principles, and keyframing strategies; Development of animated experiments and sequences that focus on convincing and exaggerated movement, physics, and acting; Introduction to range of key animation software and techniques. Restricted to Art and Design Majors Only

Typically offered in Spring only

ADN 226 Sequential Imaging (3 credit hours)
Hands-on development of story-boards, story-reels, and animatics to plan and examine visual sequences; Development of freehand sketching techniques; Exploration of drawing and image-making as a tool for visual and conceptual development; Examination of traditional and contemporary visual storytelling techniques and conventions; Exploration of common strategies for developing narrative structure. Restricted to Art and Design Majors Only.

Typically offered in Fall only

ADN 272 Introduction to Printing and Surface Design (3 credit hours)
Design and production of screen printed, painted and pattern-dyed fabrics. Development of design abilities (color use, pattern generation) and technical skills (screen printing, painting, use of fabric dyes). Production of fabric samples, studies, yardage, and/or end products. Awareness of industrial processes.

Prerequisite: C- or better in D104, ADN 111, or ADN 112
Typically offered in Fall and Spring

ADN 273 Fibers Materials and Processes (3 credit hours)
Introduction to historical and contemporary hand processes used by the textile designer. Students will learn a variety of textile techniques utilizing traditional and experimental methods. Emphasis will be on technical exploration and development.

Prerequisite: ADN 111 or ADN 112 or D 105
Typically offered in Fall and Spring

ADN 274 Basic Woven and Constructed Textiles (3 credit hours)
Hands-on introduction to structures and techniques of hand weaving and related off-loom textile structures. Focus on basic hand weaving structures, including plain weave, twills and satins, acquired through threading the loom and weaving with a variety of materials. Off-loom techniques explore a variety of structures made with simple hand tools. Projects focus on materials choice; color experimentation and control; pattern manipulations; scale and balance; and the design process as applied to hand constructed textile artifacts.

Typically offered in Fall only

ADN 275 Survey of Fibers in Art and Design (3 credit hours)
This course introduces the student to the vast world of fibers within the Art+Design community and industry. Students will learn the basics of fiber construction and terminology and explore the specialties within the fibers world (including costume design, fashion, fiber art, textile design, etc.). College of Design students only.

Design Students Only
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ADN 276 Soft Construction I: Sewing (3 credit hours)
Students will gain a fundamental understanding of traditional sewing and construction techniques using both hand and machine methods. Students may incur additional costs for project supplies. Please note that seats in this course are reserved for College of Design or Art + Design Minor (v) students only due to to limited size of labs and class demand. Students who elect to take this course a second time are expected to build upon their experience and/or to approach these concepts from a different perspective.

Prerequisite: Design Majors
Typically offered in Fall only

ADN 281 Drawing I (3 credit hours)
A beginning descriptive drawing experience which teaches students to see, analyze, and transcribe observed subject matters. The transcription incorporates formal drawing issues (line, form, texture) with traditional and contemporary material space exploration.

Prerequisite: Design Majors and Design Minors
Typically offered in Fall and Spring

ADN 288 History of Art + Design: 1918 to the Contemporary World (3 credit hours)
A survey of the History of Art and Design, 1918 to the present, focused on innovative work done in the areas of advertising, animation, comic books & graphic novels, fine arts, and emerging practices in the 21st Century, including Virtual Reality and User Experience design. Attention is paid to evolving definitions of visual culture and their critiques utilizing art historical frameworks to introduce students to methodological approaches in the field.

Typically offered in Spring only

ADN 292 Special Topics in Art + Design (1-3 credit hours)
Topics of current interest in the School of Design. Used to develop new courses.

Typically offered in Fall and Spring

ADN 311 Art + Design Laboratory I (3 credit hours)
Study of creative and contextual skills that relate to Art & Design areas of focus.

Prerequisite: ADN 111, ADN 112
Typically offered in Fall and Spring

ADN 312 Photography II (3 credit hours)
Continuation of an advanced level of the skills and techniques developed in Basic Photography. Purpose is to develop use of camera as a perceptual tool to increase awareness and sensitivity of visual imagery.

Prerequisite: ADN 212
Typically offered in Fall and Spring

ADN 319 Animation I (3 credit hours)
An intensive introduction to animation which integrates traditional hand generated animation, digital techniques and technology. Students will explore animation's fundamental principles of linear formats, sequenced movement and time-based imaging.

Prerequisite: ADN 219
Typically offered in Fall and Spring

ADN 371 Soft Construction II: Sculptural Geometry (3 credit hours)
Students will learn advanced problem solving skills through the creation of the basic set of fashion patterns and the integration of design details. Students may incur additional costs for project related supplies. This course requires field trips as possible. They are scheduled within class time and usually do not require additional cost to student. An example of previous field trips is a research trip to the Gregg. Please note College of Design or Minor of Art + Design (12DMN) Students ONLY due to to limited size of labs and class demand.

Prerequisite: Design Majors and Design Minors
Typically offered in Fall and Spring

ADN 372 Surface Embellishment (3 credit hours)
Hands-on experimentation with classic hand, machine, and digital stitching techniques on fabric; personal exploration of non-traditional materials and applications at different scales; and examination of historic and contemporary stitching through visits to the Gregg Museum and directed library and internet research.

Typically offered in Fall and Spring

ADN 373 Survey of the Fashion Industry and Design (3 credit hours)
Students will be introduced to the fashion industry, fashion history, creative process, behind the scenes, and presentation skills. Please note that 50% of seats are reserved for College of Design or Art + Design Minor (v) students only.

Typically offered in Spring only

ADN 384 Painting I (3 credit hours)
Introduction to the principles of painting through class projects that expose students to different painting materials and techniques. Students learn to build a stretcher, size and prime a canvas as well as other rigid painting surfaces. Acrylic and oil paint used; projects assigned and open themes.

Prerequisite: D 104 or both ADN 111 and ADN 112.
Typically offered in Fall only

ADN 386 Sculpture I (3 credit hours)
Studio course introducing basic concepts, materials, and processes of sculpture. Instruction incorporates both traditional and contemporary form generation with emphasis on developing formal perception and projection.

Prerequisite: D 104 or ADN 112.
Typically offered in Fall only

ADN 400 Design Studio (6 credit hours)
Studio offering Art & Design undergraduates the opportunity to intensively study general design issues (form, color, structure, proportions, scale, etc..) as applies to the study of Art + Design.

Prerequisite: ADN majors only.
Typically offered in Fall and Spring

ADN 402 Senior Art + Design Studio (6 credit hours)
Advanced Design studio emphasizing the exploration of past, current and potential future technologies within Art + Design Department content areas. Students are expected to work independently, develop their own problem statements.

Prerequisite: Seven studios and ADN 219
Typically offered in Fall and Spring

ADN 411 Art + Design Laboratory II (3 credit hours)
Study of intermediate visual communication skills that relate to Art & Design areas of focus.

Prerequisite: D 105 or ADN 111 or ADN 112 or ADN 281
Typically offered in Fall and Spring

ADN 414 Color and Light (3 credit hours)
Physical and perceptual nature of color, color awareness, sensitivity and skills in visual communication with color as a designer's tool.

Typically offered in Fall and Spring

ADN 415 Visualizing Narrative (3 credit hours)
This course will build upon previous knowledge in Art and Design through a focus on the basic historic, stylistic and compositional attributes of type to enhance storytelling in their work. Â¬Main topics addressed in the course will cover the relationship between form and content to support pacing, transition, structure, voice, action and resolution for richer visual narratives. We will use both found text as well as stories that students create in the class to explore the many ways that type can enunciate the meaning, tone and spirit of a story. There are printing fees estimated at $100 associated with this

Prerequisites: (ADN 111 (2D) and ADN 219) OR PERMISSION OF THE INSTRUCTOR. Restricted to: JUNIOR AND ABOVE STANDING IN THE MAJOR, COLLEGE OF DESIGN STUDENTS ONLY
Typically offered in Fall and Spring

ADN 418 Contemporary Issues in Art and Design (3 credit hours)
Explore a range of issues about contemporary art and design ideologies. Concentration on selected readings which provide a platform for discussion of various ideas, approaches, perspectives and practices in the contemporary fields of art and design.

Prerequisite: DS 100 and DS 200 and ADN 202 and ADN 400; Requisite: Junior Standing in ADN or Design Studies
Typically offered in Fall and Spring

ADN 419 Creative Technology Studio I (3 credit hours)
Intensive hands-on investigation of the tools, techniques, and processes for the development of interactive multi-media projects. Media teams will emphasize shaping an idea into a well thought-out design that works as an interactive experience.

Prerequisite: D 105, ADN 219
Typically offered in Fall and Spring

ADN 423 Digital Modeling (3 credit hours)
Hands on introduction to 3D digital modeling tools and techniques for artists and designers who want to expand their skill sets to include 3D practices. The course has applications in several disciplines including; animation, illustration, surface design, and concept development. Explores the use of surface textures, lighting, and compositing. Examines strategies for using 3D tools to create prototypes for physical objects, integrate 3D elements into 2D images, and create models for animation. Restricted to Art and Design Majors Only.

Typically offered in Fall only

ADN 428 Art and Design: Theory and Practice (3 credit hours)
Conceptual basis for developing a personal philosophy regarding the practice of art and design. Theory based history of diverse cultures and forces of change: political, economic, religious, social, intellectual and philosophical as they affect the fields of art and design.

Prerequisite: Senior Level (6 studios), Art and Design Major
Typically offered in Fall only

ADN 460 Creative Technology Studio II (6 credit hours)
An intensive study of advanced image-making processes, software, and various computer platforms used in the creation of multimedia. In a studio mode, students will place emphasis on creating interactive interface systems with audio and special effects.

Prerequisite: ADN 219 and ADN 400
Typically offered in Fall and Summer

ADN 470 Fibers and Surface Design Studio (6 credit hours)
Practice of widely varying textile techniques with the solving of practical and conceptual design problems. Textile end products are designed and produced at full scale in appropriate materials. Focus includes weaving, knitting, printing and dyeing of fabrics, and a wide variety of fabric construction and embellishment processes. Textile history is an ongoing part of the study. Emphasis on synthesis of techniques and ideas.

Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202)
Typically offered in Fall and Spring

ADN 472 Advanced Surface Design (3 credit hours)
Advanced problems in the design and production of hand-printed and pattern-dyed fabrics. Experimentation with advanced color application techniques. Exploration of pattern and image production on fabric and development of design abilities in textilemedia. Specific focus changes each semester.

Prerequisite: D 104, ADN 272
Typically offered in Fall and Spring

ADN 473 Advanced Three-Dimensional Fibers Forms and Structures (3 credit hours)
Advanced explorations of three-dimensional textiles forms and structures including works small and large scale installations and sculptures, planar structures in space, and textiles that interact with interior or exterior architecture, the body, or public or site-specific spaces. Technical focus on construction, joining mixed materials, armatures, integration of found materials, and both traditional and experimental structures and applications. Use of hand and power tools.

Prerequisite: ADN 273 or equivalent
Typically offered in Fall and Spring

ADN 474 Advanced Digital Hand Weaving (3 credit hours)
Introduction to use of the computer as a tool for designing, drafting, and hand weaving, using simple software packages. Hand weaving on 24-harness computer assisted looms, 8 harness hand looms, and TC-1 digital hand jacquard loom. 4 to 24 harness woven structures including twill, satin, shadow weave, double weave, woven shibori, dyed warps, and other weave structures. Focus on designing, technical skills, and solving technical problems.

Typically offered in Fall and Spring

ADN 475/ADN 575 Pre-Industrial World Textiles (3 credit hours)
Research on and discussion of hand-made textiles of the world, introducing major textile traditions from Africa, Asia, Europe, North and South America. Focus on geographic and cultural contexts, developments in making, and design characteristics, including impact of 20th century fiber art movements. Seminar format.

Prerequisite: Sophomore standing
Typically offered in Spring only

ADN 480 Intermediate Studio (6 credit hours)
Studio format offering upper level undergraduates the opportunity to intensively study general design issues (form, color, structure, proportions, scale, etc.) through individual study in drawing, painting, sculpture, photography, or printmaking.

Prerequisite: Grade of C- or better in (ADN 400 or ARC 202 or ID 202 or GD 202)

ADN 481 Drawing II (3 credit hours)
An intermediate-level drawing course that further develops the designer's graphic, analytic, observational, and conceptual skills.

Prerequisite: ADN 281
Typically offered in Fall and Spring

ADN 484 Painting II (3 credit hours)
An intermediate-level painting course that through slide lectures, class projects, and assigned readings exposes students to contemporary painting art movements. Special emphasis given to the formal and interpretative analysis of a painting. Acrylic and oil paint are used; Projects have assigned and open themes.

Prerequisite: D 105 or both ADN 111 and ADN 112.
Typically offered in Fall and Spring

ADN 486 Sculpture II (3 credit hours)
An intermediate-level sculpture course that further develops the designer's analytic, observational, and conceptual skills.

Prerequisite: ADN 386
Typically offered in Fall only

ADN 490 Art and Design International Studio (6 credit hours)
Define Art and Design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary art forms. Focus on artifact making through direct studies. Taught off campus.

Prerequisite: Junior standing, Design Majors, Approval Study Abroad Office
Typically offered in Fall, Spring, and Summer

ADN 491 Special Seminar in Art + Design (1-3 credit hours)
Seminars on subjects of current interest in art + design.

Typically offered in Fall and Spring

ADN 492 Special Topics in Art + Design (1-3 credit hours)
Topics of current interest in Design & Technology. Used to develop new courses.

Typically offered in Fall and Spring

ADN 493 Art and Design Senior Lecture (3 credit hours)
ADN 493 is a capstone course for seniors in Art and Design. The course prepares and equips students with the necessary tools and communication skills to present themselves professionally as competent practitioners. Students are required to integrate their work from previous Art and Design courses into a comprehensive portfolio and personal website. Students are required to participate in the Art and Design Senior Exhibition and provide their own transportation to the exhibition.

Prerequisite: ADN 219, ADN 281, completion of a 400 level studio; Corequisite: ADN 202 or ADN 400 or ADN 460 or ADN 470, or ADN 480
Typically offered in Spring only

ADN 494 Internship in Art + Design (1-6 credit hours)
Supervised field experience in design offices, galleries, museums and other organizations. Maximum of 6 credit hours. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing; 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

ADN 495 Independent Study in Art + Design (1-6 credit hours)
Special projects in art and design developed under the direction of a faculty member on a tutorial basis. Maximum 6 credit hours. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in Design with 3.0 in Design or better
Typically offered in Fall and Spring

ADN 496 The Business of Art and Design (3 credit hours)
A distance education elective course (ADN & DS) that introduces students to the mechanics of gainfully applying their fine and applied arts and/or design education. The course is not discipline specific. The business of design, principles of branding, project management, entrepreneurship and business development are explored through case studies, virtual class forums, independent and group assignments, and assigned readings. The course engages students in the development and management of design business planning, models, and philosophies with emphasis on social responsibility. Through coursework, students foster interpersonal, group, and leadership competencies.

Typically offered in Spring only

ADN 500 Graduate Seminar I: Software, Platforms + Environments (3 credit hours)
This course will introduce first semester Art + Design graduate students to historical and foundational theories of design and media studies-specifically related to platforms, environments and networks-to better understand the myriad ways these ideas have impacted artistic and design-based practice.

Restriction: Art + Design Graduate Students Only. Non-majors by permission of the instructor
Typically offered in Fall only

ADN 501 Graduate Seminar II: Art + Design as Future Making (3 credit hours)
This graduate-level Art +Design seminar looks at theories and methods impacting experimental media art in contemporary practice, as well as how these contemporary practices might inform future art and design-making practices. Topics in the course expose students to a wide breadth of ideas, with the opportunity to dive more deeply into concepts that are personally and professionally intriguing. Topics include: speculative and participatory art + design; biomimicry; artificial intelligence; and technology and ethics. Methods include examining idea sources, process, documentation, critiquing, speaking, and writing about visual concepts.

Restriction: Master of Art + Design Students Pre-requisite: ADN500; Co-Requisite: ADN561. This course is open to undergraduate students and Masters students outside of Art + Design by permission of the instructor.
Typically offered in Fall and Spring

ADN 502 Advanced Visual Laboratory (3 credit hours)
ADN 502 is a general title of Advanced Visual Laboratories under the supervision of an Art and Design faculty member to provide intensive experimental work in various phenomena and disciplines related to design.

Typically offered in Fall and Spring

ADN 510 Graduate Seminar III: Final Project Research (3 credit hours)
Directed research to prepare background documentation for the final project, including historical and contemporary context, theoretical frameworks and references, formation of project parameters, statement of goals, and documentation/project outline.

Prerequisites: ADN500 and ADN501 or permission of the instructor. Restricted to graduate students in Art + Design or permission of the instructor.
Typically offered in Fall and Spring

ADN 511 Graduate Seminar IV: Final Project Documentation (3 credit hours)
This graduate seminar in Art + Design supports students in the development of their final project documentation paper. More specifically, the course gives the direction to revise the historical and contemporary influences of the final project, theoretical framework, and related disciplines. Students will also develop their final project description, analysis and next steps for the project.

Prerequisite: ADN510, ADN570 or permission of the instructor. Co-Requisite: ADN571 or Permission of the Instructor. Open to Master of Design students only.
Typically offered in Fall and Spring

ADN 560 Graduate Studio I: Immersive and Experimental Narratives (6 credit hours)
Graduate Studio in Art and Design that introduces students to multiple modes of creating immersive and experiential narratives through platforms and methods such as animation and motion design, augmented reality, virtual reality, mixed reality and computational art and design.

Restriction: Art + Design Graduate Student or permission of the instructor
Typically offered in Fall only

ADN 561 Graduate Studio II: Exploring the HyperReal: Materiality, Reality and Speculation (6 credit hours)
This graduate studio will explore elements of Speculative Design that use design fiction, future casting and critical design principles to examine the past, present and future of experimental design and media experiences. Students will explore different elements of materiality and how experiences are shaped by the tangible, haptic and immersive nature of technology and media.

Typically offered in Spring only

ADN 570 Graduate Studio III: Final Project Definition (6 credit hours)
This course will provide structure to the final project development for Master of Art + Design Students. Throughout the course, students will be working independently, with instructor guidance and mentorship to develop unique, novel projects that explore new forms of immersive narrative and interactive experiences and push technical boundaries and platforms. Guest lectures and workshops may be brought into the studio throughout the semester.

Restriction: Art + Design Graduate Student or permission of the instructor
Typically offered in Fall and Spring

ADN 571 Graduate Studio IV: Final Project Development (9 credit hours)
This course will provide structure to the final project development for Master of Art + Design Students. Throughout the course, students will be working independently, with guided instruction from the Director of Graduate Programs in Art + Design, their committee chair and committee members. Guest lectures and workshops may be brought into the studio throughout the semester.

Pre-requisite: ADN570 or permission of the Instructor. Master of Art + Design Graduate Students or permission of the instructor.
Typically offered in Fall and Spring

ADN 575/ADN 475 Pre-Industrial World Textiles (3 credit hours)
Research on and discussion of hand-made textiles of the world, introducing major textile traditions from Africa, Asia, Europe, North and South America. Focus on geographic and cultural contexts, developments in making, and design characteristics, including impact of 20th century fiber art movements. Seminar format.

Prerequisite: Sophomore standing
Typically offered in Spring only

ADN 588 Final Project Studio (6 credit hours)
Final studio project for graduate students in Art & Design, under the supervision of graduate advisory committee members.

Prerequisite: ADN 570(18cr) and ADN 581. Student in last semester of graduate enrollment
Typically offered in Fall and Spring

ADN 592 Graduate Art + Design Special Topics (1-6 credit hours)
Topics of current interest to the program or concentration offered by faculty in the department of Art and Design. Subjects offered under this number are normally used to test and develop new courses.

Typically offered in Fall, Spring, and Summer

ADN 630 Independent Study in Art & Design (1-3 credit hours)
Independent study in art and design under the supervision of a specific Art & Design faculty member. Restricted to graduate students in Art & Design with consent of the supervising faculty. May not be taken in the first semester of graduate study

Prerequisite: ADN 503; and ADN 570
Typically offered in Fall, Spring, and Summer

ADN 685 Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

ADN 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Summer

ADN 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

Arts Studies (ARS)

ARS 251 The Arts of a World Capital: London (3 credit hours)
Multidisciplinary course introducing students to the architecture and museums and the musical, dance, and theatrical performances of London. Historical and social context of these works of art. The infrastructure in London that makes its unusual artistic vitality and quality possible. Taught in London.

GEP Global Knowledge, GEP Humanities, GEP Visual and Performing Arts
Typically offered in Summer only

ARS 252 The Arts of Vienna 1900 (3 credit hours)
Interdisciplinary study of art, architecture, music and theater in turn-of-the-century Vienna and of the political and scientific thinking that surrounded these arts. Taught in Vienna.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Summer only

ARS 257/STS 257 Technology in the Arts (3 credit hours)
The interaction between technology and the arts with an emphasis on developments in Western art of the twentieth century. Historical and emerging issues include: sound and film recordings, the addition of sound to films, the impact of films and television on theater, the impact of radio, computer applications to music, the visual arts, and literature.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ARS 258 Mathematics and Models in Music (3 credit hours)
Use of mathematics and models in the composition of western music of various time periods with an emphasis on the twentieth century. Critical analysis of trivial and non-trivial uses of mathematics; differentiation between mathematics as an analytical tool and mathematics as a compositional tool. Survey of models including geographical, grammatical, and graphic.

Typically offered in Spring only

ARS 259 The Arts and Politics (3 credit hours)
Interactions between the arts and politics. Specific instances and types of political art from the past and the present. Patronage, censorship, propaganda, art in times of war, the artist's options and powers, aesthetics and criticism.

GEP Visual and Performing Arts
Typically offered in Fall only

ARS 306/MUS 306 Music Composition with Computers (3 credit hours)
Survey of the theory and history of computer music, compositional algorithms, digital synthesis techniques, composition of at least one computer music work -- a computer-assisted composition for traditional instruments, a piece for computer music on tape, a real-time piece, or a piece that combines tape and instrument(s).

Prerequisite: Some knowledge of music or computer science (e.g. CSC 200)
GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARS 346/AFS 346 Black Popular Culture (3 credit hours)
A multidisciplinary examination of contemporary black cultural expression in film, music, art, and the media. Emphasis on race, class, gender, and political discourse. This class may be scheduled with a small percentage of seats held for IDS Students Only.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ARS 351 Arts, Ideas and Values (3 credit hours)
An examination of the way works of art embody a particular understanding of what is real and what is worthwhile and shape their viewers' ideas and values. Case studies approach.

GEP Visual and Performing Arts
Typically offered in Spring only

ARS 353 Arts and Cross-Cultural Contacts (3 credit hours)
Study of works of art that allude to or combine two or more traditions. Examples from film, dance, music, theater and visual arts. Analysis of the role of the exotic in art. The role of arts of multiple traditions in inaugurating new artistic movements, such as Ming landscape painting. Impact of electronic media on contemporary multicultural arts, such as Nepali pop.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

ARS 354 The Arts and the Sacred (3 credit hours)
The support and critique of religion through the arts. Study of religious symbolism embodied in works of art from a number of traditions and genres. The interrelationship between art and religion, history, culture, spirituality, and ritual.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ARS 410 Art and History of World Puppetry (3 credit hours)
Development of puppet and object performance as a major art form and network of global intercultural traditions. Study of styles and forms, technologies employed, cultural influences and movements, and the influence of traditional forms on contemporary puppetry forms. Analysis of theoretical perspectives, aesthetics, creative process, and practitioner's perspectives. Making of a puppet and a short script. Course requires students to complete a field trip off-campus outside of class times.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

ARS 414 Interdisciplinary Arts Seminar (3 credit hours)
Creation and presentation of new interdisciplinary works of art. Theory and history of such works including discussion of mixed media, multimedia and intermedia. In-class presentations and critiques. Eventual presentation of finished works in appropriate venues. Additional expenses will be incurred for Arts Now Series events

Typically offered in Fall only

ARS 494 Topics in Arts Studies (3 credit hours)
Multi-arts course focusing on selected works of art in various media, related by theme, place or date. Capstone course for students with an extensive background in one of the arts. Topics may vary.

Prerequisite: Junior standing and 15 hours in either dance, design, film studies, music, theater, or visual arts.
Typically offered in Fall and Spring

ARS 498 Independent Study in Arts Studies (1-3 credit hours)
Independent study or project directed by a faculty member in the student's area of interest. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Nine hours of course work in Arts Studies
Typically offered in Fall, Spring, and Summer

Arts Village (AVS)

AVS 100 Arts Village Forum (1 credit hours)
Direct experience with multiple arts events at the university and across the Triangle area. Through pre- and post-event presentations, discussions, and written responses, students will gain a deepened awareness of a wide variety of artistic structures, meaning, interpretation, and values. Transportation to off-campus arts events will be provided. For Arts Village Students only.

Typically offered in Fall and Spring

Biochemistry (BCH)

BCH 101/MB 101 Introduction to Microbiology and Biochemistry Laboratory Practices (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. A "hands on" introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.

Typically offered in Summer only

BCH 103 Introduction to Biochemistry (1 credit hours)
Introduction to curriculum and career requirements for biochemistry and being a successful student at NCSU. Emphasis is placed on curricular requirements, interactions with faculty and students in the Department of Molecular and Structural Biochemistry, introduction to key resource programs on campus, exposure to research opportunities and ongoing career planning. Enrollment is limited to new or transfer Biochemistry majors with less than 45 hours.

Typically offered in Fall only

BCH 220 Role of Biotechnology in Society (3 credit hours)
Role of Biotechnology in Society is an introductory science course that takes a semi-technical look at the emerging role of biotechnology in human society. Expectations are that students will gain an appreciation for biotechnology and gain the ability to understand how biotechnology works. Offered only in Poland through Study Abroad Program (4-week course).

Prerequisite: BIO 181, CH 101
GEP Interdisciplinary Perspectives
Typically offered in Summer only

BCH 330 Physical Biochemistry (3 credit hours)
This course provides a descriptive survey of the concepts of physical chemistry with emphasis on their use in applications designed to characterize and manipulate biological molecules and systems. Topics are drawn from thermodynamics (bonding, protein folding energies, linkage, specostropic and differential scanning calorimetric binding measurements), kinetics (enzymatic catalysis, perturbation techniques), statistical mechanics (distributions, ensembles, molecular mechanical & dynamics calculations), electrochemistry, hydrodynamics (diffusion, friction, electrophoresis, viscosity, sedimentation, organism size and shape), quantum mechanics (wave functions operators, uncertainty principle, dipoles, orbitals and resonance energy coupling), and spectroscopy (absorbance and light scattering, fluorescence, nuclear and electronic paramagnetic resonance, MR imaging and x-ray diffraction).

P: (CH 201 or CH 203) and (BCH 351 or BCH 451) and (MA 231 or MA 242) and (PY 208 or PY 212)
Typically offered in Spring only

BCH 351 General Biochemistry (3 credit hours)
This course is an introduction to the basic principles of biochemistry. It emphasizes biochemical structures, properties, and functions, including enzyme kinetics and major metabolic processes. It can serve as a prerequisite for BCH 452 with permission of the department. This course is designed for those students who are not majoring in Biochemistry and do not require a more comprehensive introduction to biochemistry. It is not intended for graduate students. Credit is not allowed for both BCH 351 and BCH 451. Prerequisites CH 223 (or CH 227) and BIO 183 are required. CH 201 (or CH 203) is strongly recommended, but not required.

Prerequisite: CH 223 (or CH 227), BIO 183
Typically offered in Fall, Spring, and Summer

BCH 451 Principles of Biochemistry (4 credit hours)
Introduction to and survey of the fundamental principles of biochemistry, emphasizing the chemistry of living organisms, chemical structures, and interactions of and between biomolecules.

Prerequisite: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), and BIO 183
Typically offered in Fall, Spring, and Summer

BCH 452 Introductory Biochemistry Laboratory (2 credit hours)
Laboratory experiences in this course are designed to compliment the first semester undergraduate biochemistry course, BCH 451. Basic skills to be mastered include the use of volumetric equipment, spectrophotometers, chromatography, and electrophoresis. You will also learn to assay small quantities of biological materials and analyze lab data. You will learn to manipulate biochemical materials from three of the four major subgroups: proteins, nucleic acids and carbohydrates. You will determine structural elements at a number of analytical levels and learn how to think about their functional capabilities. We will emphasize theoretical information, while discussing how the techniques work. The explanations discuss how the techniques work. We focus on how consecutive methods are interconnected to form process chains.

P: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 Organic Chemistry I (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), BIO 183 and BCH 451 (may serve as corequisite or prerequisite).
Typically offered in Fall and Spring

BCH 453/BCH 553 Biochemistry of Gene Expression (3 credit hours)
Structure and function of nucleic acids and proteins. Synthesis of DNA, RNA, and proteins. Gene expression and Regulation. Methodologies of recombinant DNA research. Credit is not allowed for both BCH 453 and BCH 553.

Prerequisite: BCH 451, Corequisite: GN 311, MB 351
Typically offered in Fall, Spring, and Summer

BCH 454 Advanced Biochemistry Laboratory (4 credit hours)
Hands on experience with the techniques of molecular biology and protein purification. Cloning and expression of a eukaryotic gene in bacteria will be performed followed by purification of the eukaryotic gene product. Microanalysis of DNA, RNA and protein.

Prerequisite: BCH 451 & BCH 452; Corequisite: BCH 453
Typically offered in Fall and Spring

BCH 455/BCH 555 Proteins and Molecular Mechanisms (3 credit hours)
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

Prerequisite: BCH 451, BCH 453/553
Typically offered in Fall and Spring

BCH 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BCH 493 Special Problems in Biochemistry (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BCH 495 Special Topics in Biochemistry (1-5 credit hours)
Offered as needed to present materials not normally available in regular BCH departmental courses or for new BCH courses on a trial basis.

Prerequisite: Junior standing.
Typically offered in Fall, Spring, and Summer

BCH 552 Experimental Biochemistry (3 credit hours)
An advanced laboratory to give students practical experiences in purification and quantitative characterization of enzymes and nucleic acids. Studies with carbohydrates and membrane lipids. Credit may be applied toward biotechnology minor.

Prerequisite: BCH 452;BCH 453
Typically offered in Fall and Spring

BCH 553/BCH 453 Biochemistry of Gene Expression (3 credit hours)
Structure and function of nucleic acids and proteins. Synthesis of DNA, RNA, and proteins. Gene expression and Regulation. Methodologies of recombinant DNA research. Credit is not allowed for both BCH 453 and BCH 553.

Prerequisite: BCH 451, Corequisite: GN 311, MB 351
Typically offered in Fall, Spring, and Summer

BCH 555/BCH 455 Proteins and Molecular Mechanisms (3 credit hours)
Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

Prerequisite: BCH 451, BCH 453/553
Typically offered in Fall and Spring

BCH 560 Molecular Biology for Teachers (3 credit hours)
Introduction to molecular biology for teachers. Emphasis will be on developing basic laboratory skills applicable to middle or high school biology classes. Teachers will develop their own labs during the last week of class. This is an intensive three-week class, five hours per day. Students should have at least one biotechnology course before enrolling in this course. Prior secondary school teaching experience preferred.

Typically offered in Summer only

BCH 571/ANS 571 Regulation of Metabolism (3 credit hours)
Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.

Prerequisite: BCH 451, GN 311, a course in physiology, cell biology
Typically offered in Fall only

BCH 590 Special Topics in Biochemistry (1-6 credit hours)
The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

BCH 601 Macromolecular Structure (1 credit hours)
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended
Typically offered in Fall only

BCH 610 Special Topics (1-6 credit hours)
The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

BCH 615 Special Topics In Biochemistry (1-6 credit hours)
Critical study of special problems and selected topics of current interest in biochemistry and related fields.

Prerequisite: Graduate standing in BCH
Typically offered in Fall, Spring, and Summer

BCH 670 Laboratory Rotations (1 credit hours)
Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned inBCH 692.

Prerequisite: BCH 451
Typically offered in Fall and Spring

BCH 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

BCH 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirement of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

BCH 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 695 Master's Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

BCH 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BCH 701 Macromolecular Structure (3 credit hours)
Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended
Typically offered in Fall only

BCH 703 Macromolecular Synthesis and Regulation (3 credit hours)
Biochemistry of DNA replication, transcription, RNA processing and translation. Development of key concepts, techniques and applications relating to mechanisms and regulation of these processes by analysis of primary literature.

Prerequisite: BCH 453 or BCH 553
Typically offered in Spring only

BCH 705 Molecular Biology Of the Cell (3 credit hours)
Regulation of cellular processes, membrane structure and function, signal transduction, protein trafficking/sorting, secretion, photosynthesis and nitrogen fixation.

Prerequisite: BCH 701 or BCH 703
Typically offered in Spring only

BCH 710 Biological Scanning Electron Microscopy (2 credit hours)
On demand. Theory and application of scanning electron microscopy, including specimen preparation, microscope alignment and operation, performance evaluation, interpretation of problems and darkroom technique. (Limited to 8 students with prior approval of instructor.)

Prerequisite: Graduate standing with some biological background
Typically offered in Spring only

BCH 751 Biophysical Chemistry (3 credit hours)
Fundamental and practical aspects of biological macromolecular structure, thermodynamics, hydrodynamics, kinetics and spectroscopy with emphasis on mechanisms in functionally important structural transformations.

Prerequisite: BCH 451; one sem. of physical chemistry
Typically offered in Fall only

BCH 760 Protein Crystallography and Macromolecular Modeling (3 credit hours)
Basic principles and practice of protein crystallography and the application of molecular dynamics to evaluate structural models. The computer lab provides hands-on experience in structure determination, refinement, model building, and molecular dynamics using CHARMM.

Prerequisite: BCH 455 or BCH 555 or equivalent
Typically offered in Fall only

BCH 761/GN 761/PB 761 Advanced Molecular Biology Of the Cell (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

Typically offered in Spring only

BCH 763 Biochemistry Of Hormone Action (3 credit hours)
Study of well-defined models of steroid and protein hormone action via lectures, assigned readings and discussions. Students add breadth to the course and depth to their own understanding by searching the literature and writing or lecturing about a particular hormone of their own choosing.

Prerequisite: BCH 705 or GN 757
Typically offered in Spring only

BCH 768/GN 768 Nucleic Acids: Structure and Function (3 credit hours)
An advanced treatment involving integrated approaches to biological problems at the molecular level, encompassing biochemistry, cell biology and molecular genetics. Broad, multidisciplinary approaches to solving research problems in biology and thecritical study of primary scientific literature, the development of a research proposal, oral presentations and class discussions.

Prerequisite: BCH 701 and 703
Typically offered in Spring only

BCH 770 Enzyme Kinetics and Mechanisms (3 credit hours)
An advanced course in enzyme kinetics and mechanisms with particular emphasis on experimental design and interpretation. The first half of the course covers the derivation and application of single and multisubstrate kinetic equations, inhibition and pre-steady state kinetics. The second half of the course covers fundamental chemical and physical principles of enzyme catalysis and specificity.

Prerequisite: BCH 451 and BCH 455/555 or equivalent.
Typically offered in Spring only

BCH 801 Seminar In Biochemistry (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

BCH 810 Special Topics (1-6 credit hours)
The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451
Typically offered in Fall, Spring, and Summer

BCH 815 Advanced Special Topics (1-6 credit hours)
Critical study of special problems and selected topics of current interest in biochemistry and related fields.

Prerequisite: Graduate standing in BCH
Typically offered in Spring only

BCH 870 Laboratory Rotations (1 credit hours)
Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned inBCH 692.

Prerequisite: BCH 451
Typically offered in Fall and Spring

BCH 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BCH 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BCH 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BCH 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BCH 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

BCH 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Biological and Agricultural Engineering (BAE)

BAE 100 Introduction to Biological Engineering (1 credit hours)
Technical topics and career options in Biological Engineering with concentrations in Agricultural, Bioprocess, and Environmental Engineering are introduced. Information is provided about career services, internships, and study abroad and co-op opportunities in these areas. Students develop a plan of work.

Typically offered in Spring only

BAE 123 Light Equipment Technology (3 credit hours)
Principles of operation and maintenance of powered turf, garden, and landscape equipment. Small engines, power transmission systems, equipment maintenance, and operator safety.

Requisite: Agricultural Institute Only
Typically offered in Spring only

BAE 133 Agricultural Tractors and Machinery (4 credit hours)
Principles of tractor engines, power trains, and hydraulics. Tractor operation, service and testing. Machinery management involving tractor and implement selection based on power and field requirements and on economics of ownership and operation. Implements for crop production to include tillage, planting, chemicals and harvesting. Set-up, operation and maintenance of implements. Calibration of planting and chemical equipment. Tractor and machinery safety. VEAL

Requisite: Agricultural Institute Only
Typically offered in Spring only

BAE 200 Computer Methods in Biological Engineering (2 credit hours)
Students develop computer-based problem solving techniques to solve introductory problems in Biological Engineering. Emphasis is on developing solution algorithms and implementing these with spreadsheets and computer programming.

Prerequisite: Grade of C or better in MA 141 and Corequisite: E 115
Typically offered in Fall and Summer

BAE 202 Introduction to Biological and Agricultural Engineering Methods (4 credit hours)
Introduction to experimental design methodology, basic engineering design and problem solving methodology for Biological Engineering. Visualization skills, computer-aided 3-D solid modeling of parts, 3-D assembly of solid part geometries, computation of mass properties, 2-D engineering drawings, engineering design process, safety, tools and fabrication processes and design, and hands-on shop fabrication of semester project.

Prerequisite: E 115
Typically offered in Spring only

BAE 203 Introduction to AutoCAD Civil 3D for Environmental & Ecological Engineers (2 credit hours)
Introduction to the use of AutoCAD Civil 3D for Environmental & Ecological Engineering applications. Basic drawing, managing survey data, surfaces, alignments, profiles, corridors, grading, pipe networks, plan production, GIS interface, GIS data types and sources, importing data, creation and export of objects in GIS formats. BE majors will be given priority in enrollment.

Prerequisite: BAE 200
Typically offered in Spring only

BAE 204 Introduction to Environmental and Ecological Engineering (2 credit hours)
Introduction to the principles and applications related to environmental and ecological engineering. Topics include watershed hydrology, nutrient cycling, sources of environmental pollution, and the impact to ecosystems. An overview of different methods employed in these two disciplines to remediate and protect natural resources. Special emphasis on how soil, water, microbial, and plant interactions occur in ecosystems and how they are used to develop treatment technologies.

Prerequisite: BAE 200 and (BIO 181 or BIO 183); Corequisite: BAE 203 and SSC 200
Typically offered in Spring only

BAE 302 Transport Phenomena (3 credit hours)
Theory and application of heat and mass transfer in biological, food, and agricultural systems. Topics include fluid flow, conduction, convection, radiation, psychrometrics, and refrigeration.

Prerequisite: MAE 201 and MA 341 and Corequisite: BAE 200 and MAE 208 and CE 282 or MAE 308
Typically offered in Fall only

BAE 305 Biological Engineering Circuits (4 credit hours)
Fundamentals of analog and digital circuit analysis and design as applied to biological engineering instrumentation systems. Analysis and design of AC and DC circuits using Ohms and Kirchhoff's laws, the node voltage method, ThÃ©venin and Norton's theorem, Laplace Transforms, resistance, capacitance, inductance, operational amplifiers, and frequency response, analog filter design, diode, transistors, biological signal acquisition, binary math and logical operators, digital circuit design, circuit simulation tools and techniques. Laboratory exercises supplement the topics presented in class lectures.

Prerequisite: MA 242, PY 208
Typically offered in Fall only

BAE 321 Bioprocessing Engineering Fundamentals (3 credit hours)
For Engineering and non-Engineering students interested in processing, biotechnology and related disciplines, it is important to have an understanding of the basic principles behind process analysis, design and scale up. This course will provide an introduction to the interdisciplinary approach and engineering concepts behind the development of useful food, chemical, energy, nutraceutical and pharmaceutical products through transformation of biological materials (bioprocessing). Some of the relevant topics covered include the fundamentals behind units, dimensions and engineering properties, stoichiometry, data analysis and statistics, mass and energy balances, rheology, mixing, heat and mass transfer, reaction kinetics and unit operations.

Prerequisite: BIO 181 or BIO 183; Corequisite: MAE 201
Typically offered in Fall only

BAE 322 Introduction to Food Process Engineering (3 credit hours)
Introductory principles and practices of handling and preserving food products. Coverage includes the design and analysis of handling systems for discrete and continuous flow material handling systems, the selection and specification of automatic controls, food preservation principles and considerations relevant to the design of food handling systems, and the principles and practices of drying and storing grain.

Prerequisite: BAE 302; MAE 308 or CE 282; MAE 301 or CHE 315
Typically offered in Spring only

BAE 325 Introductory Geomatics (3 credit hours)
Theory and practice of plane and satellite-based surveying. Includes distance measurement, differential leveling, profile leveling, topographic surveying, and record keeping. Introduction to tapes, levels, total stations, surveying software, the global positioning system, GPS receivers and methods (stand-alone, DGPS, RTK), data collection, data processing, and applications.

Prerequisite: Junior standing
Typically offered in Fall only

BAE 361 Analytical Methods in Engineering Design (3 credit hours)
Engineering problem solving through studies of topics in engineering design. Analysis of linkages, analysis and design of machine structures and components, analysis and design of power transmission components, three-dimensional modeling, and finite element analysis.

Prerequisite: BAE 202 and MAE 208 and MA 341 and Corequisite: CE 225 or MAE 214
Typically offered in Spring only

BAE 371 Fundamentals of Hydrology for Engineers (3 credit hours)
Hydrology and erosion principles. Designing structures and selecting practices to control land runoff, erosion, sediment pollution and flooding.

Prerequisite: BAE 200 and BAE 203; Corequisite: SSC 200 and CE 282 or MAE 308
Typically offered in Fall only

BAE 376 Watershed Assessment and Water Quality Protection (3 credit hours)
Application of methods to describe and protect quality. Identification of water quality problems based on physical, chemical, and biological species and intended use. Water quality sampling equipment, and sample collection strategies and methods. Macroinvertebrate sampling and interpretation. Presentation of water quality data and information. Identification of structural and non-structural best management practices (BMPs) to mitigate degradation of watersheds and ecological systems.

Prerequisite: BAE 371 Corequisite: ST 370
Typically offered in Spring only

BAE 401/BAE 501 Sensors and Controls (3 credit hours)
Basic concepts of sensors and controls for biological systems. Study of transducers and circuits utilized in biological and agricultural engineering applications. Demonstration of concepts of error, accuracy and precision, linearity and other instrument characteristics by electronic models. Provision of hands-on experience for reinforcing lecture concepts in laboratories. Credit will not be given for both BAE 401 and BAE 501.

Prerequisite: BAE 305
Typically offered in Spring only

BAE 425/BAE 525 Industrial Microbiology and Bioprocessing (3 credit hours)
Introduction to the structure and functions of microbial cells and their cultivation and utilization in Biological engineering processes. Topics covered include Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, food additives and food products such as beer, wine, cheese and yogurt, Microbial biomass production, Introduction to environmental biotechnology including wastewater treatment and bioremediation. Field trip is an essential educational component of the course and is are required. Credit will not be given for both BAE 425 and BAE 525.

Prerequisite: Junior or higher standing in CALS or COE; MB 351
Typically offered in Spring only

BAE 435/BAE 535 Precision Agriculture Technology (3 credit hours)
Overview of technology available for implementation of a comprehensive precision agriculture program. Topics include computers, GPS, sensors, mechanized soil sampling, variable rate control system, yield monitors, and postharvest processing controls. Applications of precision agriculture in crop planning, tillage, planting, chemical applications, harvesting and postharvest processing. Credit may not be received for BAE 435 and BAE 535.

Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

BAE 451 Engineering Design I (2 credit hours)
Design concepts of engineering problems are reviewed, including objectives, specifications, manufacturing, prior art and analysis. Reverse engineering, national and international standards, quality control, intellectual law and engineering ethics are covered. Team projects from agricultural, bio-processing and environmental/ecological engineering are executed through problem definition. proposal development, design, and testing. Field trips are required.

Prerequisite: (CE 225 or MAE 214) and (BAE 202 or BAE 203) and BAE 302 and BAE 401 and either (BAE 321 or BAE 322 or BAE 361 or BAE 371) Restrictive Statement: Must be within 36 credit hours of completing the BE degree.
Typically offered in Fall only

BAE 452 Engineering Design II (2 credit hours)
Continuation of BAE 451; Project analysis, design, scheduling, construction, tests, presentations and reports. Teamwork development, soft skills and the function of engineering design in society are covered. Field trips are required.

Prerequisite: BAE 451; Restrictive Statement: Must be within 36 hours of completing the BE degree.
Typically offered in Spring only

BAE 455/BAE 555 R Coding for Data Management and Analysis (3 credit hours)
This course provides students with foundational coding skills in R, an open-source statistical software environment, as well as instruction on best practices for tidying, managing, and analyzing environmental and agricultural data, including geospatial, tabular, and time series observations. As this is an introductory course, prior programming experience is not required or expected. Coding approaches taught in the course will be targeted towards developing skills needed for summarizing data, creating data visualizations, and applying simple statistical models for analysis of environmental and agricultural data.

P: ST 311, or ST 370, or ST 512, or ST 515
Typically offered in Fall only

BAE 462 Machinery Design and Applications (3 credit hours)
Machinery design for effective use of energy and labor in agricultural production. Engine cycles, power transmission, hydraulics, traction, combined stresses, finite element analysis, computer-aided-engineering, and engineering economics. Machinerydesign of agricultural field equipment and other agricultural machinery systems.

Prerequisite: BAE 361
Typically offered in Fall only

BAE 472/BAE 572 Irrigation and Drainage (3 credit hours)
Design, management and evaluation of irrigation and drainage systems; concepts and processes of system design. Credit will not be given for both BAE 472 and BAE 572.

Prerequisite: BAE 371
Typically offered in Spring only

BAE 473/BAE 573/SSC 573/SSC 473 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.

Prerequisite: BAE 371
Typically offered in Fall only

BAE 474 Principles and Applications of Ecological Engineering (3 credit hours)
Governing principles of ecological engineering and the advanced biological, chemical, and physical conditions that determine the design of biological systems. Emphasis on 1) stream and wetland ecosystem restoration and 2) natural treatment systems for groundwater, stormwater, and wastewater such as riparian buffers, bioretention cells, and stormwater wetlands. A class field trip is required during non-scheduled time.

Prerequisite: BAE 203 and BAE 204 and BAE 371 and at least one of the following, MB 351 or PB 321 or PB 360 or SSC 332; Corequisite: BAE 451
Typically offered in Spring only

BAE 478/BAE 578 Agricultural Waste Management (3 credit hours)
This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. Topics include waste characterization, descriptions of systems and technology, land application principles, preparation of waste management plans, biochemical/biological processes, and potential impacts to the environment. Assignments include homework, quizzes, projects, and discussion that emphasize problem solving and analysis.

Prerequisite: AEC/PB 360 or PB 321 or SSC 332 or MB 351
Typically offered in Fall only

BAE 481 Structures & Environment (3 credit hours)
Principles of environmental control and structural analysis are combined with biological principles for the design of structures. Topics include structural analysis, load estimation, material selection, fasteners, physiological reactions of animalsand plants to their environment, applications of heat transfer and psychrometrics in calculating ventilation requirements, heating or cooling loads.

Prerequisite: BAE 302; CE 225 or MAE 314
Typically offered in Spring only

BAE 486/BAE 586 Aquacultural Engineering (3 credit hours)
This course starts with a general background of aquaculture, both theoretical and practical. Based on this, engineering applications for both extensive (e.g. pond based) and intensive (e.g. recirculating aquaculture systems) culture systems are studied. Unit operations including biofiltration, aeration, degassing, sedimentation, pumps, piping and related topics, as well as mass balances provide quantitative engineering design tools. Transport, harvest, processing and food safety are discussed, and sustainability (ecological and environmental aspects of aquacultural engineering design) as well as cutting edge research in the area are covered. Field trips; guest lectures/discussion, and hands on work is included to provide practical applications and experience.

Prerequisite: CE 282 or MAE 308; Restrictive Statement: Senior Standing
Typically offered in Spring only

BAE 488 Postharvest Engineering (3 credit hours)
An introduction to the engineering aspects of the proper postharvest handling of fresh produce. Topics addressed include cleaning, grading, sorting, cooling, storing, packaging, transport, and marketing. Issues relating to food safety will be integrated throughout all the course content. A class field trip is required during non-scheduled time.

Prerequisite: BAE 302 or MAE 310
Typically offered in Spring only

BAE 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BAE 493 Special Problems in Biological and Agricultural Engineering (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

BAE 495 Special Topics in Biological and Agricultural Engineering (1-3 credit hours)
Offered as needed for presenting material not normally available in regular BAE departmental courses or for new BAE courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BAE 501/BAE 401 Sensors and Controls (3 credit hours)
Basic concepts of sensors and controls for biological systems. Study of transducers and circuits utilized in biological and agricultural engineering applications. Demonstration of concepts of error, accuracy and precision, linearity and other instrument characteristics by electronic models. Provision of hands-on experience for reinforcing lecture concepts in laboratories. Credit will not be given for both BAE 401 and BAE 501.

Prerequisite: BAE 305
Typically offered in Spring only

BAE 502 Instrumentation for Hydrologic Applications (3 credit hours)
Basic theory of instruments and measurements. Physical parameters of interest, available methods and sensors for assessment. Sensor characteristics. Dataloggers and sensor-datalogger communications. Data transfer, management, and processing. Emphasis on hydrologic and water quality research applications. Course offered by Distance Education only.

Prerequisite: MA 341, BAE 401 or ECE 331, ST 370 or ST 511
Typically offered in Spring only

BAE 525/BAE 425 Industrial Microbiology and Bioprocessing (3 credit hours)
Introduction to the structure and functions of microbial cells and their cultivation and utilization in Biological engineering processes. Topics covered include Fermentation systems and downstream processing methods. Enzyme kinetics, production and application. Biomanufacturing of fuels, industrial chemicals, food additives and food products such as beer, wine, cheese and yogurt, Microbial biomass production, Introduction to environmental biotechnology including wastewater treatment and bioremediation. Field trip is an essential educational component of the course and is are required. Credit will not be given for both BAE 425 and BAE 525.

Prerequisite: Junior or higher standing in CALS or COE; MB 351
Typically offered in Spring only

BAE 528 Biomass to Renewable Energy Processes (3 credit hours)
This course will introduce fundamental principles and practical applications of biomass-to-renewable energy processes, including anaerobic digestion of organic wastes for biogas and hydrogen production, bioethanol production from starch and lignocellulosic materials, biodiesel production from plant oils, and thermoconversion of biomass and waste materials. Restricted to engineering seniors and graduate standing in COE, CALS, PAMS or CNR.

Prerequisite: Introductory Organic Chemistry or Biochemistry
Typically offered in Fall only

BAE 535/BAE 435 Precision Agriculture Technology (3 credit hours)
Overview of technology available for implementation of a comprehensive precision agriculture program. Topics include computers, GPS, sensors, mechanized soil sampling, variable rate control system, yield monitors, and postharvest processing controls. Applications of precision agriculture in crop planning, tillage, planting, chemical applications, harvesting and postharvest processing. Credit may not be received for BAE 435 and BAE 535.

Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

BAE 536 GIS Applications in Precision Agriculture (1 credit hours)
Exploration of geographic information systems (GIS) and its applications in precision agriculture. Topics will include file structure and formatting, interfacing with precision agriculture equipment, georeferencing maps, merging and clipping farm data, data field calculations, designing management zones, variable rate prescriptions, and basic data analysis.

Prerequisiste: GIS 410 or GIS 510 or BAE 435 or BAE 535
Typically offered in Spring only

BAE 555/BAE 455 R Coding for Data Management and Analysis (3 credit hours)
This course provides students with foundational coding skills in R, an open-source statistical software environment, as well as instruction on best practices for tidying, managing, and analyzing environmental and agricultural data, including geospatial, tabular, and time series observations. As this is an introductory course, prior programming experience is not required or expected. Coding approaches taught in the course will be targeted towards developing skills needed for summarizing data, creating data visualizations, and applying simple statistical models for analysis of environmental and agricultural data.

P: ST 311, or ST 370, or ST 512, or ST 515
Typically offered in Fall only

BAE 560 Aerosol Science and Engineering (3 credit hours)
This course is designed for students who have a desire to work in the area of air quality. It will provide students with fundamental knowledge of aerosol properties, behavior and physical principles, and with hands-on experience in applying this knowledge to aerosol/PM measurements and control.

Prerequisite: MA 341
Typically offered in Fall only

BAE 561 Agricultural Air Quality (3 credit hours)
This course will prepare students to identify agricultural air pollutants and their sources, understand the on-farm and off-farm impacts of these pollutants, measure these pollutants, characterize and model the fate of these pollutants, and select and/or design cost-effective remediation measures. This course is restricted to seniors in engineering and MEAS, and graduate students in CALS, PAMS, and CNR.

Prerequisite: MA 341
Typically offered in Spring only

BAE 565 Environmental and Agricultural Analytics and Modeling (3 credit hours)
This course provides students with a fundamental and practical understanding of data science and modeling approaches for environmental and agricultural systems analysis. The course is organized into three modules: (1) data retrieval, management, documentation, and visualization; (2) process-based modeling; and (3) data mining through statistical analysis and machine learning. Rather than develop a strong knowledge base in a specific methodology, students will gain broad and introductory understanding of a range of contemporary quantitative approaches and learn to think critically about the use of data analytics and models.

Prerequisite: Introductory statistics (e.g. ST 515) and experience coding in R (e.g. BAE 555)
Typically offered in Spring only

BAE 572/BAE 472 Irrigation and Drainage (3 credit hours)
Design, management and evaluation of irrigation and drainage systems; concepts and processes of system design. Credit will not be given for both BAE 472 and BAE 572.

Prerequisite: BAE 371
Typically offered in Spring only

BAE 573/SSC 573/SSC 473/BAE 473 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.

Prerequisite: BAE 371
Typically offered in Fall only

BAE 574 DRAINMOD: Theory and Application (3 credit hours)
This course presents the theory of water movement and storage in poorly drained soils and applies the drainage/water management model DRAINMOD to a wide range of problems. Technical issues related to evaluation, design and management of drained soils and to wetland hydrology are analyzed. A series of problem sets provides experience in using the model, and demonstrates how the model may be applied to describe the complex interactions of multiple processses affecting hydrology of shallow water table soils.

Prerequisite: One of the following: BAE 471, BAE 472, BAE 573, BAE 771, or SSC 511
Typically offered in Spring only

BAE 575 Design of Structural Stormwater Best Management Practices (3 credit hours)
The design of structural stormwater Best Management Practices (BMPs) used in the urban and suburban environments is reviewed, including stormwater wetlands, bio-retention areas, sand filters, innovative wet ponds, green roofs, permeable pavement, and reinforced grass swales. The course is application oriented and includes a pair of field trips.

Prerequisite: BAE 471 or CE 383
Typically offered in Spring only

BAE 576 Watershed Monitoring and Assessment (3 credit hours)
Water measurement and structure sizing. Identification of water quality problems and water quality variable selection. Monitoring design, water quality sampling equipment, and sample collection and analysis. Statistical analysis and presentation of water quality data.

Prerequisite: [AES323 (SSC323/BAE323) or BAE471 or FOR429 (NR420) or CE586, and ST311 or ST361 or ST511
Typically offered in Fall only

BAE 577 Wetlands Design and Restoration (3 credit hours)
Fundamental understanding of hydrology, soils and ecology of natural wetland systems will be developed to serve as the basis for designing wetland systems for water treatment and restoring degraded natural wetland systems. Stormwater and wastewater treatment wetland design and implementation concepts will be emphasized. Wetland restoration will also be studied with emphasis on current wetland regulations, design, and implementation techniques. Engineered wetland concepts will be supplemented with relevant case studies. Basic understanding of biology, soils , hydrology, and soil and water engineering is required.

Typically offered in Spring only

BAE 578/BAE 478 Agricultural Waste Management (3 credit hours)
This course covers principles of managing, handling, treating and applying animal and poultry manures and organic byproducts from an engineering perspective. Topics include waste characterization, descriptions of systems and technology, land application principles, preparation of waste management plans, biochemical/biological processes, and potential impacts to the environment. Assignments include homework, quizzes, projects, and discussion that emphasize problem solving and analysis.

Prerequisite: AEC/PB 360 or PB 321 or SSC 332 or MB 351
Typically offered in Fall only

BAE 580 Introduction to Land and Water Engineering (3 credit hours)
This distance course introduces students to concepts of the hydrologic cycle, water quality, precipitation, evapotranspiration, infiltration, watershed delineation, surface runoff and open channel flow. Students will apply these concepts to an engineering design problem. This course is designed for non-engineering distance graduate students and lifelong education students and students from engineering disciplines outside of BAE. It will not substitute for BAE 471. The course is only open to students with senior standing or higher.

Prerequisite: MA 241
Typically offered in Fall only

BAE 581 Open Channel Hydraulics for Natural Systems (3 credit hours)
Theory and applications of hydraulics to open channels with an emphasis on natural streams and rivers. Course will introduce and develop principles of flow regimes (subcritical/critical/supercritical), and types (uniform flow, gradually varied and rapidly varied flow). Application will include hydraulics of flow measuring devices, step-backwater analysis and rating curve development, and flood studies using hydraulic models. A lab-scale flume will be used to illustrate concepts. Laptops will be used in class to learn and apply HEC-RAS (water surface profiles model). CE 382 or equivalent required. CE 381 recommended.

Prerequisite: CE 282 or equivalent. CE 381 recommended.
Typically offered in Fall only

BAE 582 Risk and Failure Assessment of Stream Restoration Structures (1 credit hours)
This course defines uncertainty and risk pertaining to stream restoration structures and identifies and quantifies sources of such. Students will review various in-stream structures and, using an example study of the rock cross vane as a guide, will investigate a structure of their choice applying the concepts of risk and uncertainty. Modules include: Introduction to structures and definitions; Types and modes of failure; Uncertainty in Stream Restoration Design; Probability of failures, cost of failures; and Failure modes and effects.

Prerequisite: CE 382 or MAE 308 or equivalent
Typically offered in Spring only

BAE 583 Stream Corridor 3 Es: Ecohydraulics, Engineering and Ethics (3 credit hours)
Overview of stream ecological and functional processes that structure stream corridors. Explore human interactions with streams including stream restoration structures and watershed scale practices that impact hydraulic, hydrologic, chemical, sedimentary and biotic functions. Discuss failure and risk analysis, policy and rights, and ethical use of our freshwater resources. As we move from a microscopic study of stream benthos to global-scale water concerns, students will develop a fluency in communicating human impacts on streams. Independent visits by students to a local stream required.

Restriction: Graduate or Senior Standing
Typically offered in Spring only

BAE 584 Introduction to Fluvial Geomorphology (3 credit hours)
This distance course provides an introduction to applied fluvial geomorphology as it relates to natural physical stream processes. Students will learn about watershed hydrology, stream gage data analysis, bankfull stage identification, hydraulic geometry relationships, stream channel assessment and classification, stream stability and channel evolution.

Prerequisite: BAE 471 or BAE 580
Typically offered in Fall only

BAE 586/BAE 486 Aquacultural Engineering (3 credit hours)
This course starts with a general background of aquaculture, both theoretical and practical. Based on this, engineering applications for both extensive (e.g. pond based) and intensive (e.g. recirculating aquaculture systems) culture systems are studied. Unit operations including biofiltration, aeration, degassing, sedimentation, pumps, piping and related topics, as well as mass balances provide quantitative engineering design tools. Transport, harvest, processing and food safety are discussed, and sustainability (ecological and environmental aspects of aquacultural engineering design) as well as cutting edge research in the area are covered. Field trips; guest lectures/discussion, and hands on work is included to provide practical applications and experience.

Prerequisite: CE 282 or MAE 308; Restrictive Statement: Senior Standing
Typically offered in Spring only

BAE 587 Biogeochemical processes for Ecological engineering and Environmental Sciences (3 credit hours)
The course provides the advanced theoretical knowledge of biogeochemical processes at play in man-made and natural filter systems, such as wetlands and other buffer systems, alleviating common pollutants associated with non-point source pollution, both in rural and suburban watersheds. Particular emphasis is put on the fate of excess nitrogen in these systems. This emphasis serves as a model for describing ecological engineering principles and quantifying processes at play for all pollutants. 20 students max. This course puts together biological, chemical, biochemical, and hydrological knowledge in one ensemble. Minimum proficiency in each of these is necessary to be able to follow the class with ease.

Typically offered in Fall only

BAE 590 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.

Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering

BAE 591 Master's Research Methods I (1 credit hours)
This is the first in a series of research methods courses for MS students majoring in Biological and Agricultural Engineering. Students will develop research questions to be answered by their thesis project and produce a literature review focusing on those questions. Students will also observe formal seminar presentations, providing critiques and participating in discussions of proper seminar delivery. This course is restricted to MS students majoring in BAE.

Typically offered in Fall only

BAE 592 Master's Research Methods II (1 credit hours)
This is the second in a series of research methods courses for MS students majoring in Biological and Agricultural Engineering. Students will develop a research proposal for their thesis work and will present the proposal in a final seminar. This course is restricted to MS students majoring in BAE.

Prerequisite: BAE 591
Typically offered in Spring only

BAE 593 Introduction to Research Communications (1 credit hours)
This course introduces graduate students to the process of reading, analyzing, and communicating, in writing and multiple presentation formats, the findings of scientific literature searches. Students will progress from superficial reading to critical analysis of literature and will present their analyses in written, poster, presentation, and video formats. Related issues in research and professional communication will be discussed.

Prerequisite: Graduate Students in BAE Only
Typically offered in Fall only

BAE 610 Special Topics (1-6 credit hours)
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

Prerequisite: Graduate standing
Typically offered in Fall only

BAE 620 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.

Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering
Typically offered in Fall and Spring

BAE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

BAE 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BAE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall only

BAE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BAE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

BAE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall and Spring

BAE 771/SSC 771 Theory Of Drainage--Saturated Flow (3 credit hours)
Discussion of physical concepts and properties of fluids and porous media in relation to soil-water movement. Derivation and discussion of the fundamental laws and equations governing saturated flow in porous media. Analysis of mathematical solutions of steady-state and transient flow equations to determine their applicability to drainage problems. Consideration of analogs and models of particular drainage problems.

Prerequisite: MA 301
Typically offered in Fall only

BAE 785/FS 785 Food Rheology (3 credit hours)
Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing.

Prerequisite: FS 231 or MAE 314
Typically offered in Fall only

BAE 790 Special Topics (1-6 credit hours)
Special topics in BAE.

BAE 791 Doctoral Research Methods I (1 credit hours)
This is the first in a series of research methods courses for PhD students majoring in Biological and Agricultural Engineering. Students will develop PhD level research questions to be answered in their dissertation project and will produce a PhD level literature review on those questions. Students will also observe seminars, providing critiques and discussions of proper seminar delivery. This course is restricted to PhD students majoring in BAE

Typically offered in Fall only

BAE 792 Doctoral Research Methods II (1 credit hours)
This is the second in a series of research methods for PhD students majoring in Biological and Agricultural Engineering. Students will develop a research proposal appropriate for their dissertation project and will present the proposal in both a practice and final seminar. The course is restricted to PhD students majoring in BAE.

Prerequisite: BAE 791
Typically offered in Spring only

BAE 801 Seminar (1 credit hours)
Elaboration of subject areas, techniques and methods peculiar to professional interest through presentations of personal and published works; opportunity for students to present and critically defend ideas, concepts and inferences. Discussions to point up analytical solutions and analogies between problems in biological and agricultural engineering and other technologies, and to present relationship of biological and agricultural engineering to socio-economic enterprise.

Prerequisite: Graduate standing in BAE
Typically offered in Fall and Spring

BAE 810 Special Topics (1-6 credit hours)
A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty.

Typically offered in Fall only

BAE 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering.

Prerequisite: Senior standing or Graduate standing in Biological and Agricultural Engineering
Typically offered in Fall and Spring

BAE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BAE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BAE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BAE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BAE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

BAE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertation.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Biological Sciences (BIO)

BIO 105 Biology in the Modern World (3 credit hours)
Concepts in biology taught from the perspective of civically engaging issues or problems. Themes and topics of wide interest, such as climate change, stem cells and cloning, antibiotic resistance, evolution, and human health. Lecture and the corresponding laboratory are designed to deepen an appreciation for the connections between science and "real-world" issues. For non-science majors. Students cannot receive credit for both BIO 105 and (BIO 181 or BIO 183).

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 106 Biology in the Modern World Laboratory (1 credit hours)
Laboratory experience in biological principles to complement BIO 105. For non-science students. Students may not receive credit for both BIO 106 and (BIO 181 or BIO 183).

Corequisite: BIO 105; May not receive credit for both BIO 106 and (BIO 181 or BIO 183)
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 140 Survey of Animal Diversity (3 credit hours)
Classification and phylogeny of animals; patterns of diversification in body design and relationship between body design and the environment; study of selected animal assemblages. Students may not receive credit for both BIO 140 and (BIO 350 or BIO 402 or BIO 403). Students may not receive credit for both BIO 140 and BIO 350 or BIO 402 or BIO 403 or ZO 150.

GEP Natural Sciences
Typically offered in Fall only

BIO 141 Animal Diversity Laboratory (1 credit hours)
Observation of living animals, dissections of preserved specimens, and microscopy; emphasis on classification of animals, patterns of diversification in body design, and relationship between body design and the environment. Students may not receive credit for both BIO 141 and BIO 350 or BIO 402 or BIO 403 or ZO 150.

Prerequisite: BIO 140
GEP Natural Sciences
Typically offered in Fall only

BIO 165 Introduction to Environmental Research (5 credit hours)
Introduction to environmental research is a hands-on learning experience for incoming freshmen interested in pursuing scientific research. The course introduces students to scientific methods and research through active participation in research on an environmental problem involving chemicals of environmental concern. Students will explore a topic in this field through guided readings, field samplings, and lab experimentation. Restricted to incoming freshmen who have been accepted into the HHMI RISE program. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

GEP Interdisciplinary Perspectives
Typically offered in Summer only

BIO 181 Introductory Biology: Ecology, Evolution, and Biodiversity (4 credit hours)
Introduction to ecology, evolution, and biodiversity within the context of structure and function including the adaptive strategies that organisms use to manage the everyday challenges of life. Emphasis on interactions of organisms with their environments, evolutionary change and role of natural selection in the evolution of life forms. Builds a foundation for understanding how science works, how to think critically and communicate scientifically.

X: Cannot receive credit for both BIO 181 and BIO 105 or BIO 106.
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 183 Introductory Biology: Cellular and Molecular Biology (4 credit hours)
Basic concepts and principles of molecular, cellular, and developmental biology. Emphasis is placed on the physical basis of life, on the molecular mechanisms that guide evolution, on the cell as the fundamental unit of life, and on the mechanisms involved in the development of multicellular organisms. The course promotes the development of crucial scientific skills including critical thinking, problem solving, design of experiments, and effective oral and written scientific communication. Students cannot receive credit for both BIO 183 and (BIO 105 or BIO 106).

Prerequisite: BIO 181 or CH 101
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

BIO 227 Understanding Structural Diversity through Biological Illustration (3 credit hours)
Biological concepts of diversity and anatomy taught through direct observation and illustrative techniques. Lecture topics include plant ID and structure, microscopic life forms, animal anatomy and identification. Laboratory work emphasizes close observation of structures and comparative anatomy as well as illustrative techniques to produce accurate drawings of specimens. Students will be required to provide their own transportation for one field trip.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Spring only

BIO 230 The Science of Studying Dinosaurs (3 credit hours)
This course introduces students to the scientific method as applied to the study of dinosaurs and the world in which they lived. Because we cannot directly observe dinosaurs, estimating biological features such as running speed, growth rates, and reproductive and other physiological strategies presents challenges. We will examine a range of biological concepts (including cellular biology and physiology, functional morphology and biomechanics, evolutionary relationships, and paleoecology), as well as geological concepts (such as sedimentology, radiometric dating, plate tectonics, and the geologic time scale) as they apply to dinosaurs as living organisms. An understanding of biology at the introductory college level will be assumed.

Prerequisite: C- or better in BIO 181 or BIO 183 or BIO 105
GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall only

BIO 240 Principles of Human Anatomy & Physiology (A): Nervous, Skeletal, Muscular, & Digestive Systems (4 credit hours)
BIO 240 provides an introduction to the anatomy and physiology of the nervous, skeletal, muscular, and digestive systems. Fundamental principles addressed throughout the course include (1) maintenance and regulation of homeostasis, (2) communication and control processes throughout the body, (3) integration and interdependence across organ systems, (4) structure-function relationships, and (5) anatomical and physiological adaptation. Together, BIO 240 and BIO 245 provide a strong foundation in human anatomy and physiology (through both lecture and lab) for students preparing for a variety of health-related professions.

Prerequisite: C- or better in BIO 183; Cannot receive credit for both this course and BIO 212 or BIO 421
Typically offered in Fall, Spring, and Summer

BIO 245 Principles of Human Anatomy & Physiology (B): Endocrine, Cardiovascular, Respiratory & Renal Systems (4 credit hours)
BIO 245 provides an introduction to the anatomy and physiology of the endocrine, cardiovascular, respiratory, and renal systems. Fundamental principles addressed throughout the course include (1) maintenance and regulation of homeostasis, (2) communication and control processes throughout the body, (3) integration and interdependence across organ systems, (4) structure-function relationships, and (5) anatomical and physiological adaptation. Together, BIO 240 and BIO 245 provide a strong foundation in human anatomy and physiology (through both lecture and lab) for students preparing for a variety of health-related professions.

Prerequisite: C- or better in BIO 183; Cannot receive credit for both this course and BIO 212 or BIO 421
Typically offered in Fall, Spring, and Summer

BIO 267 Research in the Life Sciences I: Research Skills (3 credit hours)
This course is designed to help first year students learn basic skills associated with scientific research. Class structure is interactive and relies on group collaboration for most projects. Students will become confident in reading and analyzing scientific literature, communicating scientific principles, compiling a poster presentation, presenting at scientific conferences, and attending local scientific symposia as well as practicing some basic laboratory techniques. The 2-semester Research PackTrack Program (BIO 267 and 269) is designed to prepare undergraduates for an original research experience in a scientific laboratory. A B- or better in BIO 267 is required to take BIO 269. Students in BIO 267 are required to attending one research symposium outside of regular class time. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: C- or better in BIO 181 and Corequisite: BIO 183
Typically offered in Fall and Spring

BIO 269 Research in the Life Sciences II: Guided Research (3 credit hours)
This course is designed to provide students with a laboratory framework for conducting original research and (together with BIO 267) preparation to move on to conducting research in a scientific laboratory. Students will generate their own research goals, write research proposals, conduct original mentored independent research, and present their findings at poster symposia both at NC State and at local conferences.

Prerequisite: C- or better in BIO 183 and B- or better in BIO 267
Typically offered in Fall and Spring

BIO 270 Introduction to Evolution (3 credit hours)
Evolution is the "grand unifying theory" that underlies all of modern biology. In this team-taught, lecture and discussion-based introductory course, students will learn about: the history of the concept of evolution and how it is discussed in modern society; sources of variation and forces of evolution; microevolution, speciation, and the nature of species; common descent, phylogeny, and the tree (and web) of life; macroevolution and modeling evolutionary trends; and the role of the fossil record, including that of our own lineage, in understanding evolution in deep time. Students will learn core foundational knowledge and how to discuss and contextualize evolutionary concepts.

Prerequisite: C- or better in BIO 181 or in (BIO 105 and 106)
Typically offered in Fall and Spring

BIO 310 Quantitative Approaches to Biological Problems (3 credit hours)
This course serves as an introduction to the use of mathematical, statistical and computational models and tools for understanding biology at the molecular, population, ecological and evolutionary scales. We will use discrete and continuous mathematics to model disease spread, ecological competition and biochemical systems. We explore the effect of random events in biochemistry and learn how to model such randomness in a statistical framework. We will also use computation tools to analyze genetic data and write a short computer program that simulates the change in allele frequencies in a population in time due to random effects. All course topics will involve hands-on computational exercises, but no prior experience in these tools and methods is expected.

Prerequisite: BIO 181 and MA 131 or MA 141 (or equivalents).
Typically offered in Spring only

BIO 315 General Parasitology (3 credit hours)
General principles of parasitic symbiosis. Emphasis on life cycles, epidemiology, and pathology of major parasites of humans and domestic animals.

Prerequisite: C- or better in BIO 181 and BIO 183
Typically offered in Fall and Summer

BIO 323 Paleoecology (3 credit hours)
Paleoecology offers insights into the ancient ecosystems of Earth across millions of years and how the study of these extinct realms compares and contrasts with ecological studies of the modern world. Students will learn about ancient organisms through firsthand observation of fossil specimens, will have hands-on experience with paleontological data collection, and will learn to perform data analysis on paleontological datasets. At least one optional weekend field trip (illustrating concepts learned in class) will be offered during the semester.

Prerequisite: BIO 181
Typically offered in Fall only

BIO 325 Paleontological Field Methods (4 credit hours)
Understanding the history of life is not possible without first and foremost unearthing it. Discovering, collecting, and conserving fossil specimens for research is a time- and labor-intensive endeavor that requires hands-on training in the field. This course provides introductions to the evolution of life; Mesozoic biodiversity, biostratigraphy, and biogeography; vertebrate skeletal anatomy; stratigraphic and sedimentary concepts; and geomorphology. The course also covers paleontological research methods, including: specimen data collection, conservation, and preparation; topographic and geologic maps; GPS techniques; prospecting and excavation of fossil localities; and taphonomic indicators. Field work in Utah; additional costs involved.

Prerequisite: BIO 120 or BIO 181 or BIO 330
Typically offered in Summer only

BIO 330 Evolutionary Biology (3 credit hours)
Principles and patterns of organic evolution. Topics will include the origin of life, patterns of genetic variation, adaptations, natural selection, and the formation of species, the relationship between micro and macroevolution, and the importance of evolution to humans and medicine.

Prerequisite: C- or better in BIO 181and BIO 183
Typically offered in Spring only

BIO 361 Developmental Biology (3 credit hours)
In this course students will discover the amazing journey that cells must take to get from an egg to an embryo, form a mature adult, and reproduce in order to continue the life cycle. Students will relate science to everyday life using developmental biology as a forum to integrate many aspects of biology from the molecules in single cells to the complete organism and how it is influenced by evolution and the environment. Cannot receive credit for both BIO 361 and GN 434.

Prerequisite: C- or better in BIO 183
Typically offered in Fall only

BIO 370 Developmental Anatomy of the Vertebrates (3 credit hours)
An integrated study of the functional anatomy, phylogeny, and embryonic development of organ systems in vertebrate animals.

Prerequisite: C- or better in BIO 181 or BIO 140
Typically offered in Spring only

BIO 375 Developmental Anatomy Laboratory (2 credit hours)
A hands-on study of embryonic development and organ systems in vertebrate animals, utilizing microscopic examination of living and preserved embryos, demonstrations of skeletons and mammalian organs, and dissections of preserved shark, salamander, and mink.

Prerequisite: C- or better in BIO 181 or BIO 140
Typically offered in Spring only

BIO 405 Functional Histology (3 credit hours)
Offered only as a distance education course via the internet. Functional Histology describes the cellular structure of tissues and organs. Human organs are emphasized, with brief consideration given to variation in other mammals. Tissue and organ structure is related to function, including examples of malfunction (histopathology). The course is especially appropriate for students planning a career in veterinary science, medicine, or allied health fields. Offered by distance education only.

Prerequisite: C- or better in BIO 183
Typically offered in Summer only

BIO 414 Cell Biology (3 credit hours)
The chemical and physical bases of cellular structure and function with emphasis on methods and interpretations.

Prerequisite: C- or better in BIO 183 and (CH 221 or CH 225)
Typically offered in Spring only

BIO 416 Cancer Cell Biology (3 credit hours)
Cancer cells are defective and yet they survive and often thrive despite having these defects. We will explore changes in tumor cells as they transition from normal cells - looking at disrupted growth signaling and cell death pathways, alterations in cell motility patterns and the induction of changes in other cells. Current research and treatments will be discussed. A focus will be on problem solving and critical thinking skills as we integrate case studies as well as primary and review literature into the course. This course will involve lecture, discussion, and group activities. Students will be expected to do assigned reading prior to coming to class, make presentations or lead discussions, analyze data, and design experiments.

P: C- or better in BIO 183 and GN 311. JR or SR standing; Students may not earn credit for both BIO/PB 414 and BIO 416.
Typically offered in Fall only

BIO 418 Cell Biology Research Lab (2 credit hours)
BIO 418 is a laboratory course that emphasizes collaborative, inquiry-based learning through research. Students will design and implement experiments to explore mechanisms relating to cellular growth, metabolism, cell signaling pathways, environmental toxins, and/or intrinsic and extrinsic apoptotic processes in various cell lines. This course will include primary literature analysis, experimental design and implementation, maintenance of lab notebooks, data analysis, discussions, and presentations.

C: BIO/PB 414 or BIO 416. JR or SR standing
Typically offered in Fall and Spring

BIO 424 Endocrinology (3 credit hours)
This course will explore the function of hormones and bioactive compounds in regulating animal physiology and homeostasis. Topics will include a study of hormones and their mechanism of actions in regulating various biological processes including development and growth; reproduction; feeding, digestion and metabolism; ion and water balance; stress and immunity; and sex determination. The methods used to study hormones and their physiological functions will also be addressed. 80% of enrollment is restricted to Biological Sciences and Zoology students with the remaning 20% open for all other majors.

Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245
Typically offered in Fall, Spring, and Summer

BIO 432 Evolutionary Medicine (3 credit hours)
This course introduces the rapidly emerging field of evolutionary medicine as one approach to appreciating evolution as a unifying principle of biology. The primary goal is for students to better understand the evolutionary nature of many issues connected to human health and to better understand the field of evolution via examples that are medically relevant. The course will require reading and discussing scientific literature. Credit is not allowed for both BIO 432 and BIO 330.

R: Junior or Senior standing; Prerequisite: C- or better in BIO 181 or BIO 183 or GN 311.
Typically offered in Spring only

BIO 434 Hormones and Behavior (3 credit hours)
This course will focus on the field of behavioral neuroendocrinology, which explores mechanisms by which hormones affect and are affected by behavior. The course will use highly interactive lectures and discussions of material from the primary literature (seminal papers and recent exciting contributions). Student participation in class discussions and in-class assignments will be critical components of the learning process.

Prerequisite:C- or better in BIO 212 or Bio 250 or (ANS 205 & ANS 206) or BIO 240 or BIO 245
Typically offered in Spring only

BIO 440 The Human Animal: An Evolutionary Perspective (3 credit hours)
An in-depth look at the evolution of a wide range of human behaviors, and some aspects of physiology as well. We will critically explore the perceptions we hold of ourselves and the research that has sought to lend new insights into the fundamental bases of human behavior. New uses of evolutionary theory, including the field of evolutionary psychology, will be examined using a comparative approach and careful readings from primary and secondary literature in evolutionary biology and psychology. Classes will be largely discussion based.

Prerequisite: C- or better in one of the following: ZO 317, BIO 270, BIO 330, ZO 410, PSY 406, or PSY 416
GEP U.S. Diversity
Typically offered in Spring only

BIO 444 The Biology of Love and Sex (3 credit hours)
The need to find and seduce a mate is one of the most powerful forces in biology. In this course, we will examine the biological factors that contribute to love and sex. We will adopt a broad evolutionarily-based perspective, examining a variety of strategies in both human and animal systems. Our readings and discussions will cover current hypotheses and experimental methodologies spanning genetics, neuroscience, and endocrinology.

P: C- or better in two of the following: BIO 330, BIO 410, BIO 424, BIO 488, GN 311; R: Junior or Senior Standing
Typically offered in Spring only

BIO 481 Senior Capstone Project (1 credit hours)
This course provides students an opportunity to integrate and apply knowledge and skills gained from their major studies in addressing an important challenge or problem that they identify. Emphasis will be placed on (1) reflections on the value of experiences outside of the classroom, (2) using discipline-specific knowledge and approaches from both biology and from the second disciplinary area that they chose to study within the B.A. in Biological Sciences, and (3) peer- and self-critiques based on the intellectual standards of critical and creative thinking. Restricted to seniors who will graduate with a B.A. in Biological Sciences. 17BIOBA majors only.

Typically offered in Fall, Spring, and Summer

BIO 482 Capstone Course in Molecular, Cellular, and Developmental Biology (3 credit hours)
Topical problems in molecular, cellular, and developmental biology. BIO 482 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the MCD curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

Prerequisite: C- or better in BIO 361, BIO/PB 414, and one of the following: BCH 351 or BCH 451 or BIT 410 or GN 311.
Typically offered in Fall and Spring

BIO 483 Capstone Course in Integrative Physiology and Neurobiology (3 credit hours)
Topical problems in integrative physiology and neurobiology. BIO 483 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the IPN curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

Prerequisite: C- or better in BIO 424, BIO 488, and one of the following: BIO/PB 414 or BCH 351 or BCH 451 or GN 311 or ST 311.
Typically offered in Fall and Spring

BIO 484 Capstone Course in Human Biology (3 credit hours)
Topical problems in human biology. BIO 484 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the HB curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

Prerequisite: C- or better in BIO 421, MB 351 and one of the following: BCH 351 or BCH 451 or GN 311 or ST 311.
Typically offered in Fall and Spring

BIO 485 Capstone Course in Ecology, Evolution, and Conservation Biology (3 credit hours)
Topical problems in ecology, evolution, and conservation biology. BIO 485 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and on effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the EEC curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

Prerequisite: C- or better in BIO/PB 330, BIO/PB 360, and one of the following: BIO 460 or GN 311 or NR 406 or ST 311.
Typically offered in Fall and Spring

BIO 488/BIO 588 Neurobiology (3 credit hours)
Overview of the neurosciences, with a focus on fundamental principles in the function, structure, and development of the nervous system. Topics include neuroanatomy, electrical signaling, synaptic transmission, sensory and motor systems, neural development, neural plasticity, and complex brain functions. Multiple levels of analysis, from molecular to behavioral, with an emphasis on the mammalian nervous system. Motivated students who do not meet listed prerequisite can contact the instructor for permission to take the course.

Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245 or permission of instructor
Typically offered in Fall only

BIO 498 Honors Project Part I (3 credit hours)
Together, BIO 498 and BIO 499 provide a two-semester sequence for honors projects conducted by students in good standing in an honors program within the Department of Biological Sciences. Before enrollment in BIO 498, students (1) identify a project in consultation with a faculty member, (2) work with that mentor to complete a contract describing the expectations for their work together in BIO 498, and (3) have the contract approved by the honors program coordinator. The approved contract will describe the specific requirements and expectations of the BIO 498 experience. Enrollment only by permission of the honors program director.

Typically offered in Fall, Spring, and Summer

BIO 499 Honors Project Part 2 (3 credit hours)
Together, BIO 498 and BIO 499 provide a two-semester sequence for honors projects by students in good standing in an honors program within the Department of Biological Sciences. Before beginning BIO 499, students will have successfully completed BIO 498 as well as a contract describing the expectations for their work with the mentor in BIO 499. The contract must be approved by the honors program director. The approved contract will describe the specific requirements and expectations of the BIO 499 experience. Enrollment only by permission of honors program director.

Prerequisite: BIO 498
Typically offered in Fall, Spring, and Summer

BIO 520 Skeletal Biological Laboratory Methods in Human Identification & Cold Cases (3 credit hours)
This laboratory-based course covers skeletal biological methods such as those used in human identification applied to medicolegal issues or issues of the law. Forensic identification methods will be introduced via lecture and students will apply these methods in the laboratory. The investigation of cold cases will be addressed through laboratory methodologies that intersects with missing persons cases. This course covers a broad array of investigative skeletal methods. However, students will not be qualified to practice after taking this course.

P: Graduate Standing
Typically offered in Fall only

BIO 555/PSC 555 Creative Media Production for Scientists (3 credit hours)
This course will be an introduction to producing videos and other online science media. Students will survey and discuss research-based best practices for online science media and will produce their own media pieces.

R: Grad Standing or Instructor Approval
Typically offered in Spring only

BIO 560/BMA 560 Population Ecology (3 credit hours)
Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.

Co-requisite: ST 511
Typically offered in Spring only

BIO 570 Evolutionary Ecology (3 credit hours)
This course provides a detailed overview of evolutionary ecology, the multidisciplinary interface of ecological and evolutionary processes. The course includes an historical perspective of the development of the field, major theoretical and empirical milestones, and the cutting edge of modern evolutionary ecology research and application. This is a discussion-oriented course, drawing heavily from peer-reviewed literature. Grading is centered on participation, leading discussions, critical literature reviews, and a research project. The course Moodle website will contain files for all assigned readings, the course syllabus, tips for leading discussions, and a schedule of class meetings and discussion leaders.

Prequisite: Graduate Standing or C- or better in AEC/PB 360 and Corequisite: C- or better in BIO 330 or BIO 432
Typically offered in Fall only

BIO 572/CH 572/BIT 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.

Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

BIO 578 The Physiology of Stress (3 credit hours)
Stress is a nearly unavoidable component of modern life, bound to affect each of us at some point during the week (or day!) And stress can wreak havoc on both mental and physical health. Beginning with a look at the normal stress response in humans and animals, this course then examines the biological effects of both physical and psychological stress. We'll examine what happens to various systems in the body when the stress response occurs and doesn't shut down. Among the systems explored will be neuroendocrine, cardiovascular, digestive, immune, and reproductive. We'll also look at how stress affects sleep, depression, prenatal and childhood development, and memory and judgment. And we'll spend some time with stress management techniques (and why they do or don't work) as well.

P: Graduate Standing
Typically offered in Fall only

BIO 588/BIO 488 Neurobiology (3 credit hours)
Overview of the neurosciences, with a focus on fundamental principles in the function, structure, and development of the nervous system. Topics include neuroanatomy, electrical signaling, synaptic transmission, sensory and motor systems, neural development, neural plasticity, and complex brain functions. Multiple levels of analysis, from molecular to behavioral, with an emphasis on the mammalian nervous system. Motivated students who do not meet listed prerequisite can contact the instructor for permission to take the course.

Prerequisite: C- or better in BIO 250 or BIO 212 or BIO 240 or BIO 245 or permission of instructor
Typically offered in Fall only

BIO 592 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.

Typically offered in Fall, Spring, and Summer

BIO 624 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.

Typically offered in Fall and Spring

BIO 705/CBS 705 Fundamentals of Neuroscience (3 credit hours)
This is a fundamental course that will provide the student with an up-to-date coverage of molecular, cellular, physiological, and circuit-based aspects of Modern Neurosciences in the Comparative Biomedical Sciences Graduate Program. Being a graduate-level class, the instructors will assume that the students have acquired some background in basic biology and biochemistry. The most important goal of this course is to train PhD students in neuroscience function and disorders, preparing them for neuroscience research. Emphasis will be placed on the systems and skills needed to pursue experimental neuroscience activities. Important components of the learning process will be presentations from neuroscience experts, class discussions, exams and in class activities.

P: BIO 488 or permission of instructor
Typically offered in Fall only

BIO 727/CH 727 Biological Mass Spectrometry (3 credit hours)
Fundamentals of mass spectrometry including topics such as: mass, isotopic distributions, resolving power, mass accuracy. Ionization source topics: electron impact, chemical ionization, matrix-assisted laser desorption ionization, electrospray ionization and contemporary methods. Instrumentation and mass analyzers: quadrupole, time-of-flight, Fourier transform based mass analyzers; hybrid instruments such as a quadrupole orbitrap. Tandem mass spectrometry and dissociation. Applications: quantitation, small molecule analysis, and peptide sequencing.

Prerequisite: CH 223 or CH 227
Typically offered in Fall only

BIO 792 Topical Problems (1-6 credit hours)
Organized, formal lectures and discussion of a special topic.

Typically offered in Fall, Spring, and Summer

BIO 805/CBS 805 Special Topics in Neuroscience (1 credit hours)
Topics in neuroscience. This course will provide an opportunity for students to integrate and apply knowledge and skills gained from their graduate studies. Emphasis will be placed on primary literature, scientific practice, and on effective, professional communication and presentations. Topics and instructors will vary from semester to semester. Priority will initially be given to graduate students participating in the neuroscience concentration; other students with the necessary prerequisites will be admitted on a space available basis.

R: Grad Standing or Instructor Approval
Typically offered in Spring only

BIO 811 Forensic Sciences Seminar (1 credit hours)
This is a webinar series that includes professional development as well as practitioner presentations about the current state of the various forensic sciences disciplines. Topics covered fill in the background and gaps needed for a career as a forensic science practitioner and/or academician.

Prerequisite: Graduate Standing or Instructor Permission
Typically offered in Fall only

BIO 824 Topical Problems (1-3 credit hours)
Organized, formal lectures and discussion of a special topic.

Typically offered in Fall and Spring

Biomanufacturing Training Education Center (BEC)

BEC 220 Introduction to Drug Development and Careers in Biomanufacturing (1 credit hours)
Introduction to discovery and development of biopharmaceuticals, industrial enzymes, food ingredients and biologics. Discussion of majors that prepare students for positions in the biotechnology industry. Lectures from staff and from professionalsin the biotechnology industry focus on drug development, biopharmaceutical process development, design of biomanufacturing facilities, overview of methods used for manufacturing biopharmaceuticals, drug and enzyme purification, formulation, as well as careers in FDA compliance documentation related to manufacturing products using microbial biotechnology.

Typically offered in Fall and Spring

BEC 330 Principles and Applications of Bioseparations (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Description of common purification equipment, processes and materials used for cell lysis, precipitation, flocculation, membrane filtration, column chromatography, and centrifugation. Laboratories provide students with exposure to various techniques and the parameters that control protein isolation and purification of a recombinant protein. This is a half-semester course. Students who have completed BIT(CHE) 464 may not complete this course for credit.

Prerequisite: CH 223 or CH 227
Typically offered in Fall and Spring

BEC 425/BEC 525 Molecular Biology for Biomanufacturing (2 credit hours)
This course is an introduction to fundamental molecular biology techniques, applied to generate bacterial cell lines for the production of recombinant proteins. Course material provides a comprehensive description of an expression system, with emphasis on the central dogma of molecular biology, detailed gene structure, vector components and bacterial host cell characteristics. Different genetic, physiologic and growth condition aspects are included to ensure the overproduction of a functional protein of interest. This comprises different molecular approaches for gene cloning, bacterial selection/screening and regulation of genetic expression. The course provides hands-on experience during laboratory sessions, where students isolate a gene of interest, clone the gene into an expression vector, transform bacteria, select for positive clones, grow recombinant cells, and induce the production of the protein of interest. Techniques such as SDS-PAGE, Western blot, and ELISA are used for the detection and quantification of the active recombinant protein.

Prerequisite: BIO 183 or equivalent
Typically offered in Fall, Spring, and Summer

BEC 426/BBS 526/FS 526/BEC 526/BBS 426/FS 426 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

BEC 436/BEC 536 Introduction to Downstream Process Development (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Laboratories in the intermediate-scale pilot plant provide students with exposure to various unit operations and the parameters that control protein isolation and purification of a recombinant protein produced by an E. coli. This is a half-semester course. Students who have completed BEC 436 may not take BEC 536 for credit.

Prerequisite: BEC 330 or graduate standing
Typically offered in Fall and Spring

BEC 445/BEC 545 Cell Line Development for Biomanufacturing (2 credit hours)
This course provides the basic and advanced principles of genetic engineering in yeast and mammalian cells for the overproduction of a protein of interest. Students will use classical and novel strategies to establish a stable Chinese hamster ovary (CHO) cell line based on the industrially relevant strain, DG44 (DHFR system). Students will also generate a yeast expression system based on Pichia pastoris for the production of the same protein. The generation of two different cell lines for the overproduction of the same protein of interest should provide students with an appreciation of each system in terms of cost, speed, productivity and product quality.

Corequisite: BEC 425/525 or Prerequisite: BIT 410/510 or MB 351 or MB 352 or MB 354
Typically offered in Fall and Spring

BEC 448/BEC 548/CHE 548/CHE 448 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

BEC 462/BEC 562/CHE 462/CHE 562 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

BEC 463/BIT 563/CHE 563/BEC 563/BIT 463/CHE 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall, Spring, and Summer

BEC 475/BEC 575 Global Regulatory Affairs for Medical Products (3 credit hours)
This lecture-based course introduces students to the quality systems used to meet the regulatory requirements for developing, testing, manufacturing, and selling medical products in the global marketplace. It provides a general background for those going into the medical products field, but is especially useful to students preparing for a career in the Regulatory Affairs or Quality Assurance Department within a pharmaceutical, biomanufacturing, or medical device company. BEC 575 students must have graduate standing.

Prerequisite: Senior standing
Typically offered in Fall and Spring

BEC 480/BEC 580 cGMP Fermentation Operations (2 credit hours)
Application of microbial fermentation techniques at production scale and evaluation of the inherent issues resulting from the integration of microbial fermentation unit operations, scale-up/production, and current Good Manufacturing (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in media preparation, bioreactor operation, process utilities, and manufacturing quality systems that simulate microbial cell growth and product expression in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 480 may not take BEC 580 for credit.

Corequisite: BBS/BEC/FS 426
Typically offered in Fall and Spring

BEC 483/BME 583/BEC 583/BME 483 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.

Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BEC 485/BEC 585 cGMP Downstream Operations (2 credit hours)
Application of downstream bioprocessing techniques at production scale and evaluation of the inherent issues resulting from the integration of recovery and purification unit operations, scale-up/production issues, and current Good Manufacturing Practice (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in cell removal, cell disruption, purification, and manufacturing quality systems that simulate downstream bioprocessing in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 485 may not take BEC 585 for credit.

Corequisite: BEC 436/536
Typically offered in Fall and Spring

BEC 488/CHE 488/BEC 588/CHE 588 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

BEC 495 Special Topics in Biomanufacturing (1-4 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis. Departmental approval required.

Typically offered in Fall, Spring, and Summer

BEC 497 Biomanufacturing Research Projects (1-3 credit hours)
Introduction to biomanufacturing research through experimental, theoretical, and literature studies. Oral and written presentation of reports. Departmental approval required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

BEC 515 Biopharmaceutical Product Characterization Techniques (2 credit hours)
This 8 week graduate course introduces engineering students to bioanalytical testing to processes that produce structurally complex biopharmaceuticals. Students will gain hands-on experience including assay validation, drug/biologic substance characterization (structural and activity) and biopharmaceutical purity. The technologies and related theory will include rapid micro SDS-PAGE, lab-on-a-chip, HPLC, mass spectrometry, UV/Vis absorbance and fluorescence spectroscopy. Students will also learn assay development and validation concepts as per ICH Q2(R1) and other U.S. and international government regulatory guidelines.

Prerequisite:CH 222 or equivalent
Typically offered in Fall only

BEC 525/BEC 425 Molecular Biology for Biomanufacturing (2 credit hours)
This course is an introduction to fundamental molecular biology techniques, applied to generate bacterial cell lines for the production of recombinant proteins. Course material provides a comprehensive description of an expression system, with emphasis on the central dogma of molecular biology, detailed gene structure, vector components and bacterial host cell characteristics. Different genetic, physiologic and growth condition aspects are included to ensure the overproduction of a functional protein of interest. This comprises different molecular approaches for gene cloning, bacterial selection/screening and regulation of genetic expression. The course provides hands-on experience during laboratory sessions, where students isolate a gene of interest, clone the gene into an expression vector, transform bacteria, select for positive clones, grow recombinant cells, and induce the production of the protein of interest. Techniques such as SDS-PAGE, Western blot, and ELISA are used for the detection and quantification of the active recombinant protein.

Prerequisite: BIO 183 or equivalent
Typically offered in Fall, Spring, and Summer

BEC 526/BBS 426/FS 426/BEC 426/BBS 526/FS 526 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

BEC 532 Biological Processing Science (2 credit hours)
Fundamental scientific principles underlying the recovery, purification and formulation of biologics (biotherapuetics), especially proteins, are examined. Emphasis is placed on delineating the key chemical and physical properties of biomolecules that impact processing and formulation development. Laboratories in the analytical and small-scale purification facility provide students with 'hands-on' exposure to key scientific principles and small scale unit operations. This is a half-semester course.

Prerequisite: BCH 451 or graduate standing
Typically offered in Fall and Spring

BEC 536/BEC 436 Introduction to Downstream Process Development (2 credit hours)
Objectives, strategies, and approaches for recovery and purification of biomolecules, especially recombinant proteins. Laboratories in the intermediate-scale pilot plant provide students with exposure to various unit operations and the parameters that control protein isolation and purification of a recombinant protein produced by an E. coli. This is a half-semester course. Students who have completed BEC 436 may not take BEC 536 for credit.

Prerequisite: BEC 330 or graduate standing
Typically offered in Fall and Spring

BEC 545/BEC 445 Cell Line Development for Biomanufacturing (2 credit hours)
This course provides the basic and advanced principles of genetic engineering in yeast and mammalian cells for the overproduction of a protein of interest. Students will use classical and novel strategies to establish a stable Chinese hamster ovary (CHO) cell line based on the industrially relevant strain, DG44 (DHFR system). Students will also generate a yeast expression system based on Pichia pastoris for the production of the same protein. The generation of two different cell lines for the overproduction of the same protein of interest should provide students with an appreciation of each system in terms of cost, speed, productivity and product quality.

Corequisite: BEC 425/525 or Prerequisite: BIT 410/510 or MB 351 or MB 352 or MB 354
Typically offered in Fall and Spring

BEC 548/CHE 548/CHE 448/BEC 448 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

BEC 562/CHE 462/CHE 562/BEC 462 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

BEC 563/BIT 463/CHE 463/BEC 463/BIT 563/CHE 563 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

BEC 575/BEC 475 Global Regulatory Affairs for Medical Products (3 credit hours)
This lecture-based course introduces students to the quality systems used to meet the regulatory requirements for developing, testing, manufacturing, and selling medical products in the global marketplace. It provides a general background for those going into the medical products field, but is especially useful to students preparing for a career in the Regulatory Affairs or Quality Assurance Department within a pharmaceutical, biomanufacturing, or medical device company. BEC 575 students must have graduate standing.

Prerequisite: Senior standing
Typically offered in Fall and Spring

BEC 577/CHE 577 Advanced Biomanufacturing and Biocatalysis (3 credit hours)
Overview of biomanufacturing using microorganisms (bacteria, yeast, fungi), eukaryotic cells (hybridomas, insect, plant, CHO) and recombinant enzymes focusing on methods used in industry. Course will emphasize process design for optimization of heterologous protein expression, metabolic/cell line engineering, metabolomics, protein engineering to alter enzymes and antibodies. Pathway engineering strategies include developing microbes to produce new therapeutic compounds or overproduce primary metabolites, antibiotics, biotherapeutics, therapeutic enzymes, diagnostics, recombinant vaccines, and biopharmaceuticals. Utilization of immobilized biocatalysts, and microbial kinetics are covered.

Graduate standing in engineering or life-science graduate program
Typically offered in Spring only

BEC 580/BEC 480 cGMP Fermentation Operations (2 credit hours)
Application of microbial fermentation techniques at production scale and evaluation of the inherent issues resulting from the integration of microbial fermentation unit operations, scale-up/production, and current Good Manufacturing (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in media preparation, bioreactor operation, process utilities, and manufacturing quality systems that simulate microbial cell growth and product expression in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 480 may not take BEC 580 for credit.

Corequisite: BBS/BEC/FS 426
Typically offered in Fall and Spring

BEC 583/BME 483/BEC 483/BME 583 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.

Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BEC 585/BEC 485 cGMP Downstream Operations (2 credit hours)
Application of downstream bioprocessing techniques at production scale and evaluation of the inherent issues resulting from the integration of recovery and purification unit operations, scale-up/production issues, and current Good Manufacturing Practice (cGMP) compliance. Lectures prepare students for pilot-scale laboratory experiences in cell removal, cell disruption, purification, and manufacturing quality systems that simulate downstream bioprocessing in a commercial cGMP facility. This is a half-semester course. Students who have completed BEC 485 may not take BEC 585 for credit.

Corequisite: BEC 436/536
Typically offered in Fall and Spring

BEC 588/CHE 588/BEC 488/CHE 488 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

BEC 590 Industry Practicum in Biomanufacturing (3 credit hours)
This is an industry case study course emphasizing scientific, engineering, analytical, and professional skills related to biomanufacturing of human therapeutics; the course will provide students with the opportunity to design a complete cGMP process and facility capable of licensure.

Typically offered in Fall only

BEC 595 Special Topics in Biomanufacturing (1-6 credit hours)
Offered to present graduate course content not available in existing courses or for offering of new graduate courses on a trial basis. Departmental approval required.

BEC 601 Biomanufacturing Seminar (1 credit hours)
Weekly seminars on topics of current interest in biomanufacturing and affiliated subjects. Seminars will be presented by resident faculty members, graduate students and visiting lectures from industry, government regulatory agencies such as the FDA or from academic programs related to biomanufacturing.

Typically offered in Fall and Spring

BEC 620 Leadership and Preparation for Industry Internship in Biomanufacturing (2 credit hours)
Advanced communication skills specific to the regulatory requirements of the biomanufacturing and biopharmaceutical industries regulated by the U.S. FDA. Instructors teach writing professional and technical resumes, advanced interview skills, team or project leadership, teamwork and communication skills required by industry to prepare and present discipline-specific documents to the FDA. Students learn change management in a biopharmaceutical company and how to develop emotional intelligence. Interviews by industry professionals give each student experience and feedback. Restricted to students with graduate standing.

Typically offered in Spring only

BEC 669 Biomanufacturing Research Projects (1-4 credit hours)
Introduction to biomanufacturing research through experimental, theoretical and literature studies under the mentorship of a member of the graduate faculty. Oral and written presentation of reports. Deptartmental approval required.

Prerequisite: Graduate standing in engineering, biological science or physical science
Typically offered in Fall, Spring, and Summer

Biomathematics (BMA)

BMA 560/BIO 560 Population Ecology (3 credit hours)
Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.

Co-requisite: ST 511
Typically offered in Spring only

BMA 567 Modeling of Biological Systems (4 credit hours)
An introduction to quantitative modeling in biology. Use of Forrester diagrams, probabilistic and deterministic description of dynamic processes, development of model equations, simulation methods and criteria for model evaluation. Examination of current literature dealing with application of models and simulation in biology. Individual and class modeling projects.

Prerequisite: MA 131

BMA 573/MA 573 Mathematical Modeling of Physical and Biological Processes I (3 credit hours)
Introduction to model development for physical and biological applications. Mathematical and statistical aspects of parameter estimation. Compartmental analysis and conservation laws, heat transfer, and population and disease models. Analytic and numerical solution techniques and experimental validation of models. Knowledge of high-level programming languages required.

Prerequisite: MA 341 and knowledge of high-level programming language.
Typically offered in Fall only

BMA 574/MA 574 Mathematical Modeling of Physical and Biological Processes II (3 credit hours)
Model development, using Newtonian and Hamiltonian principles, for acoustic and fluid applications, and structural systems including membranes, rods, beams, and shells. Fundamental aspects of electromagnetic theory. Analytic and numerical solution techniques and experimental validation of models.

Prerequisite: MA/BMA 573
Typically offered in Spring only

BMA 590 Special Topics (1-6 credit hours)
Special topics in BMA.

Typically offered in Fall, Spring, and Summer

BMA 591 Special Topics (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.

Typically offered in Fall, Spring, and Summer

BMA 610 Special Topics (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.

Typically offered in Fall, Spring, and Summer

BMA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

BMA 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall and Spring

BMA 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

BMA 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BMA 771/MA 771/ST 771 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories oftwo and more species systems (predator-prey, competition, symbosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structureof models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.

Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only

BMA 772/MA 772/ST 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.

Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only

BMA 773/MA 773/OR 773/ST 773 Stochastic Modeling (3 credit hours)
Survey of modeling approaches and analysis methods for data from continuous state random processes. Emphasis on differential and difference equations with noisy input. Doob-Meyer decomposition of process into its signal and noise components. Examples from biological and physical sciences, and engineering. Student project.

Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

BMA 774/OR 774/MA 774 Partial Differential Equation Modeling in Biology (3 credit hours)
Modeling with and analysis of partial differential equations as applied to real problems in biology. Review of diffusion and conservation laws. Waves and pattern formation. Chemotaxis and other forms of cell and organism movement. Introduction to solid and fluid mechanics/dynamics. Introductory numerical methods. Scaling. Perturbations, Asymptotics, Cartesian, polar and spherical geometries. Case studies.

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501
Typically offered in Spring only

BMA 790 Special Topics (1-6 credit hours)

BMA 801 Seminar (1 credit hours)
Graduate students in biomathematics are expected to attend through most of their residence period.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

BMA 815 Advanced Special Topics (1-6 credit hours)
Directed readings, problem sets, written and oral reports as dictated by need and interest of student; new 600-level courses during the development phase (currently includes courses in stochastic modeling and biophysical theory).

Typically offered in Fall, Spring, and Summer

BMA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BMA 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BMA 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

BMA 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Biomedical Engineering (BME)

BME 201 Computer Methods in Biomedical Engineering (3 credit hours)
Students develop computer-based problem solving techniques using Excel and MATLAB to solve introductory problems in Biomedical Engineering. Emphasis is on developing solution algorithms, implementing these with spreadsheets and computer programming, and presenting results in a clear and concise manner. Students registered for BME 201 who fail to matriculate into BME will be dropped from the course.

Prerequisite: BME matriculated students
Typically offered in Fall only

BME 205 Introduction to Biomedical Mechanics (4 credit hours)
Study of the state of rest or motion of bodies subjected to the action of forces. Properties of force systems, free body diagrams, concepts of equilibrium, kinematics of particles, newton's laws, conservational principles of energy of momentum in mechanics, mechanical vibrations and their applications in biomedical systems. Restricted to student in the Biomedical Engineering Department.

Credit cannot be received for both BME 205 and (CE 214 or MAE 206)
Typically offered in Spring only

BME 207 Biomedical Electronics (4 credit hours)
Fundamentals of analog and digital circuit analysis and design as applied to biomedical instrumentation and measurement of biological potentials. Passive circuit components, node and mesh analysis, transient behavior, operational amplifiers, frequency response, analog filter design, diode, transistors, biological signal acquisition, binary math and logical operators, digital circuit design, circuit simulation tools and techniques. Laboratory exercises supplement the topics presented in class lectures.

Prerequisites: PY 208/209, BME Majors Only
Typically offered in Spring only

BME 209 Introduction to the Materials Science of Biomaterials (4 credit hours)
This course covers the chemistry, physics, and engineering theory underlying materials science and also discusses the diagnostic and analytical techniques necessary to assess these properties experimentally. This strong foundation prepares students to conceive and build better materials for a wide assortment of biomedical applications.

Co-req: PY 208/209. Pre-req: BME Students Only. Credit cannot be received for BME 209 and (MSE 200, MSE 201, MSE 203 or BME 203)
Typically offered in Fall only

BME 215 Biomedical Mechanics Laboratory (1 credit hours)
This laboratory is part of BME 205 - Biomedical Mechanics and complements it with relevant labs and examples. Statics and dynamics subjects will be studied with experimental techniques, including strain gauges and accelerometers, and computational methods, including finite-element analysis and motion capture. Finally, the human arm will be studied to derive forces, moments, and kinematic properties during various exercises. BME student only.

Co-requisites: MAE 208
Typically offered in Spring only

BME 217/BMME 217L Biomedical Electronics Laboratory (1 credit hours)
Laboratory in analog and digital circuit analysis. Electrical safety; Exercises in resistor networks, capacitors and inductors, steady-state and dynamic circuit behavior, active circuits, amplifiers, logic gates, combinatorial and sequential circuits, elementary digital system design, A/D conversion, biomedical applications.

Prerequisite: ECE 331, BME Majors
Typically offered in Spring only

BME 219 Materials Science of Biomaterials Lab (1 credit hours)
Introductory laboratory experience focused on integrating biological engineering and materials engineering principles by exploring key topics in materials science. Topics include biomaterial fabrication, evaluation of their physical properties and interpretation of results.

Pre-requisite: MSE 200 or MSE 201 or MSE/BME 203. Credit cannot be received for both BME 219 and BME 209
Typically offered in Fall only

BME 295 Research in Biomedical Engineering for Undergraduates (1-3 credit hours)
Opportunity for faculty mentored research in biomedical engineering. Approved plan of work required with significant independent research culminating in a final paper. Students must identify an advisor or co-advisor from within the BME faculty with whom to work on a regular basis. The advisor and BME Undergraduate Affairs Committee must approve the student project prior to the student registering for the course.

R: BME Majors, Departmental Approval Required
Typically offered in Fall and Spring

BME 298 Biomedical Engineering Design and Manufacturing I (2 credit hours)
This is the first in a series of four courses in Biomedical Design. The course introduces the tools and problem-solving skills required in the field of Biomedical Engineering.

Co-requisites: PY 208/209, BME Majors only
Typically offered in Fall only

BME 299 BME Design and Manufacturing I Lab (1 credit hours)
BME 299 together with BME 252 or another course in CAD design fulfills the requirements of BME 298 Biomedical Engineering Design and Manufacturing I. In this course students learn some of the practical fundamentals of electronics manufacturing. Activities include use of bench equipment, soldering techniques, circuit board types, how to identify common electronic components and how they work in a circuit and simple C programming for microcontrollers.

Prerequisite: BME 252. Credit cannot be received for both BME 298 and BME 299
Typically offered in Fall only

BME 301/BMME 301 Human Physiology : Electrical Analysis (4 credit hours)
This course includes a quantitative approach to human physiology from the biomedical engineering perspective with an emphasis on neural, sensory, muscle, and cardiac physiology. Autonomic and somatic motor control will be discussed. Engineering applications, including neural stimulators, functional imaging, cochlear implants, artificial noses, vestibular implants, visual implants, artificial larynges, pacemakers and defibrillators will be discussed. Assignments include computer-based exercises using MATLAB.

Prerequisites: BIO 183, BM(M)E 201, [BME 210 or BM(M)E 207]
Typically offered in Fall only

BME 302 Human Physiology: Mechanical Analysis (4 credit hours)
This course explores a quantitative approach to human physiology from the biomedical engineering perspective with an emphasis on systems physiology described using mechanical properties. Topics include the physiological and mechanical behavior of the blood vessels, lungs, kidney muscles and larynx. In the course lab exercises, students investigate mechanical properties of fluids, electrolyte exchange in dialysis, spirometry and blood pressure measurement among other topics. The course culminates with the design of a novel laboratory experiment.

Prerequisite: BIO 183, [BM(M)E 205 or MAE 208], [BM(M)E 209 or BMME 150]
Typically offered in Spring only

BME 315 Biotransport (3 credit hours)
Quantification and modeling of heat and mass transfer in biomedical systems. Topics include heat transfer rate equations, conservation of energy, steady-state and transient heat transfer, Brownian motion, Fick's laws, conservation of mass equations, molecular transport through membranes, porous media, Stoke-Einstein relations, boundary layer theory, mass transfer coefficients and hemodialysis.

Prerequisite: BME/BMME 201 and (MA 341 or MA 331)
Typically offered in Spring only

BME 325 Biochemistry for Biomedical Engineers (3 credit hours)
An overview of how alterations in bioenergetics, enzyme catalysis, protein and membrane structure, carbohydrate, lipid and nucleic acid metabolism affect human health and how biomedical engineering tools are used to detect and monitor the problems by understanding these biochemical processes. Topics include: Biological Thermodynamics, Energy of macromolecular structure and binding, Structure/function of proteins, enzymes and nucleic acids, Kinetics, enzyme catalysis and biochemical network analysis, Generation of chemical and electrical potential in membranes, Carbohydrate/lipid/protein metabolism and energy production, DNA synthesis, transcription, Technologies used to monitor/detect biochemical processes including clinical imaging modalities.

Prerequisite: CH 221, (BME 209 or BME 203)
Typically offered in Fall only

BME 335/BMME 335 Biomaterials (3 credit hours)
Fundamental sciences behind the design and selection of biomaterials, including crystallography, polymer science, characterization, mechanical testing, and surface preparation. Integration of biomaterials into the body and its response, including inflammation and rejection. Semester-long research project.

Pre-req: BIO 183, (BME 209 or BME 203)
Typically offered in Spring only

BME 345 Biomedical Solid Mechanics (3 credit hours)
This course covers topics ranging from multi-body systems to stress superposition to failure criteria to prepare students for the more advanced subjects of biomechanics and rehabilitation engineering. Topics include the following: Free-body diagrams, Multibody statics and dynamics, Linkage kinematics and kinetics, Anthropometric kinematics, Stress/strain/torsion, Beam bending, Stress superposition, Constitutive relationship, Strain gauges, Finite-element analysis, Failure analysis, Failure mechanisms.

P: BME 201 and (BME 205 or MAE 208) and (BME 209 or BME 203)
Credit cannot be received for BME 345 and (MAE 214 or CE 313)
Typically offered in Spring only

BME 355 Biocontrols (3 credit hours)
Quantitative analysis of dynamic and feedback control systems, including modeling of physiological systems and physiological control systems, system time and frequency responses, control characteristics, and stability analysis. Design techniques for feedback systems in biomedical applications.

C: BM(M)E 365
Typically offered in Spring only

BME 365/BMME 365 Linear Systems in Biomedical Engineering (3 credit hours)
Fundamentals of linear systems analysis as applied to problems in biomedical modeling and instrumentation. Properties of biomedical systems and signals. Representation of continuous- and discrete-time signals and system response. Convolution. Fourier analysis in continuous and discrete domains. Laplace transform. Frequency response and its application in biomedical systems. Filter design. Circuit analogs to mechanical and thermodynamics systems and their applications in modeling biomedical systems. Applications in biomedical instrumentation. Students use MATLAB to simulate and analyze biomedical linear systems. BME majors only.

Pre-reqs: [BM(M)E 207 or BME 210], BM(M)E 201. Co-reqs: MA 341 or MA 331
Typically offered in Fall only

BME 375/BMME 375 Biomedical Microcontroller Applications (3 credit hours)
Overview of microcontroller-based systems, including applications, architecture, number systems, and languages. Students gain experience using a PIC-based microcontroller to input information from a user and output information using LEDs and LCD displays. Student will learn capabilities of the PIC through in class exercises and weekly programming assignments. Both assembly language and PIC-based C are used. Students develop a PIC-based heart rate monitor and work in pairs on a BME-related project of their choice.

Pre-reqs: [BM(M)E 207 or BME 210], BM(M)E 201. Co-reqs: BM(M)E 385 or BME 422
Typically offered in Fall only

BME 385/BMME 385 Bioinstrumentation (3 credit hours)
Fundamentals of biomedical instrument design and implementation. Sensing mechanisms, sensor microfabrication methods, sensor interfacing circuits, analog-to-digital conversion, biosignal capture and storage, embedded microprocessors, data compression methods, system integration and prototyping. Laboratory exercises using LabVIEW and MATLAB, supplement the topics presented in class lectures. Students build a sensor using cleanroom facilities in the BME department as part of a semester-long design project.

Pre-reqs: [BM(M)E 207 or BME 219], BM(M)E 201
Typically offered in Fall only

BME 398/BMME 398 Biomedical Engineering Design and Manufacturing II (2 credit hours)
Students will be required to continue their use of the tools learned in Biomedical Design and Manufacturing I in the context of modern design practices and manufacturing processes. The organizational and project management tools of moderm design will be introduced, and a technical discussion of a modern manufacturing technology will be introduced each week.

Pre-reqs: BM(M)E 298, [BM(M)E 207 or BME 210], BM(M)E 201
Typically offered in Spring only

BME 412 Biomedical Signal Processing (3 credit hours)
Fundamentals of continuous- and discrete-time signal processing as applied to problems in biomedical instrumentation. Properties of biomedical signals and instruments. Descriptions of random noise and signal processes. Interactions between randombiomedical signals and systems. Wiener filtering. Sampling theory. Discrete-time signal analysis. Applications of Z-transform and discrete Fourier transform. Digital filter design methods for biomedical instruments. BME or MS or PHD; credit not allowed for both BME 412 and BME 512.

Pre-reqs: BM(M)E 365 or BME 311
Typically offered in Spring only

BME 418/BME 518/ECE 518/ECE 418 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.

Prerequisite: Senior standing
Typically offered in Fall only

BME 425/BME 525 Bioelectricity (3 credit hours)
Quantitative analysis of excitable membranes and their signals, including plasma membrane characteristics, origin of electrical membrane potentials, action potentials, voltage clamp experiments, the Hodgkin-Huxley equations, propagation, subthresholdstimuli, extracellular fields, membrane biophysics, and electrophysiology of the heart. Design and development of an electrocardiogram analysis system.

Prerequisite: BME 302 or (ZO 421 and a course in electrical circuits)
Typically offered in Spring only

BME 444/BME 544 Orthopaedic Biomechanics (3 credit hours)
Students study human body kinematics, force analysis of joints, and the structure and composition of biological materials. Emphasis is placed on the measurement of mechanical properties and the development and understanding of models of biological material mechanical behavior.

P: BM(M)E 301, BM(M)E 302, [BM(M)E 345 or MAE 214 or CE 313]
Typically offered in Fall only

BME 451/BMME 451 BME Senior Design: Product Development (3 credit hours)
This course is part of a three year sequence and it expands on the skills and knowledge gained in BM(M)E 398. Students continue to learn the process of engineering design and learn new skills to produce solutions for unmet medical needs.

Pre-reqs: BME 398, BME 301 or 302, 2 gateway or specialty electives completed
Typically offered in Fall only

BME 452/BMME 452 BME Senior Design: Product Implementation and Strategy (3 credit hours)
This course is part of a three-year sequence and it expands on the skills and knowledge gained in prior design courses. Students continue to learn the process of engineering design and learn new skills to produce solutions for unmet medical needs. Implementation phase of the senior design experience.

Pre-reqs: BME 398, BME 301 or 302, 2 gateway or specialty electives completed; Co-req: taking at least 3 gateway or specialization electives
Typically offered in Spring only

BME 462 Biomaterials Characterization (3 credit hours)
Introductory laboratory experience focused on integrating engineering and biological principles by exploring key topics in biomaterials. Topics include evaluation and interpretation of experimental results, modeling and testing of tissues and cells, and biomaterial/tissue, cell interactions. BME and MSE Majors only; Juniors and Seniors.

Pre-reqs: [BM(M)E 325 or BCH351 or BCH 451], [BM(M)E 335 or MSE 485] and BME Majors.
Typically offered in Spring only

BME 466/TE 566/BME 566/TE 466 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioresorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)
Typically offered in Fall only

BME 467/TE 467 Mechanics of Tissues & Implants Requirements (3 credit hours)
Application of engineering and biological principles to understand the structure and performance of tendons, ligaments, skin, and bone; bone mechanics; viscoelasticity of soft biological tissues; models of soft biological tissues; mechanics of skeletal muscle; and tissue-derived devices as well as interfaces between native tissues and synthetic devices.

Prerequisite: (ZO 160 or BIO 183) and (MAE 214 or CE 225)
Typically offered in Spring only

BME 481 Quality Management Systems for Engineers (3 credit hours)
This course is designed for biomedical engineering students who plan to work in industry. The course covers industry related topics including team work, conflict resolution, manufacturing and specifications, gap analysis, and root cause of analysis. Design topics including design of experiments, and standards and regulations relevant to the biomedical engineering profession are also covered. Lean and six sigma are taught with an option to test for a six sigma green belt if a six sigma project is completed in the following semester.

Co-reqs: BMME 697 or BME 451
Typically offered in Fall only

BME 483/BEC 483/BME 583/BEC 583 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.

Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BME 484/BME 584 Fundamentals of Tissue Engineering (3 credit hours)
This course covers essential concepts of organ and tissue design and engineering using living components, including cell-based systems and cells/tissues in combination with biomaterials, synthetic materials and/or devices. Topics include: In vivo tissue structure and function; Isolation and culture of primary cells and stem cells; Principles of cellular differentiation; Mass transport processes in cell culture systems; Design, production and seeding of scaffolds for 3D culture; Design of bioreactors to support high-density cell growth; State-of-the-art engineered tissue systems; Clinical translation; and Ethics.

Prerequisite: BIO 183, CH 221, and (MAE 201 or MSE 301 or CHE 315 or TE 303 or BME 315 or BME 325)
Typically offered in Spring only

BME 490 Special Topics in Biomedical Engineering (1-4 credit hours)
Offered as needed for presenting material not normally available in regular BME Department courses or for new BME courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BME 491 Biomedical Engineering Honors Thesis I (3 credit hours)
First in a two-semester sequence of research courses that partially fulfills the requirements for graduation with departmental honors. Prior approval needed for enrollment. Students should identify a research mentor and research topic before applying. Minimum GPA requirement and written report are required. The course does not meet a graduation requirement, and can only be used to meet the requirements of graduation with departmental honors.

Typically offered in Fall and Spring

BME 492 Biomedical Engineering Honors Thesis II (3 credit hours)
Second in a two-semester sequence of research courses that partially fulfills the requirements for graduation with departmental honors. Students work with a mentor on an independent research project. Minimum GPA requirement and written report are required. The course does not meet a graduation requirement if used to meet the requirements of graduation with departmental honors.

Prerequisite: BME 491 and project continuation approval by the BME Undergraduate Research Committee
Typically offered in Fall and Spring

BME 498 Undergraduate Research in Biomedical Engineering (3 credit hours)
Opportunity for hands-on faculty mentored research project in biomedical engineering. Course may be a stand-alone project completed in one semester/summer or serve as part of a two-semester project. Approved plan of work required with significant independent research culminating in a final paper and presentation at the NC State Undergraduate Research Symposium or other appropriate venue. Students must identify an advisor from within the BME faculty with whom to work on a regular basis. The advisor must approve the student prior to the student registering for the course. The BME Undergraduate Coordinator must approve the use of the course as a restricted elective for the BME degree. Departmental Approval Required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

BME 501 Biomedical Innovation and Entrepreneurship I - Needs Discovery (4 credit hours)
This course utilizes clinical immersion to identify medical device and other healthcare opportunities. Students will be exposed to diverse healthcare environments and learn to triage opportunities based on financial, regulatory and intellectual property landscapes. Guest lectures will feature experts in the medical device, pharmaceutical and healthcare industries as well as local entrepreneurs.

Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Summer only

BME 502 Biomedical Innovation and Entrepreneurship II - Design and Regulation (4 credit hours)
This course teaches path-to-market concepts including regulatory aspects unique to medical devices and pharmaceuticals. Topics include detailed analyses of Phase I-IV clinical trials, 510(k) and PMA approvals, Investigational Device Exemption (IDE) Investigational New Drug (IND) application, Good Laboratory Practices (GLP) and clinical research organizations (CROs). Students will participate in frequent visits to local biotech companies. Guest lectures will feature experts in FDA processes, clinical research and early stage biotech ventures.

Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Fall only

BME 503 Biomedical Innovation and Entrepreneurship III - Product Development (4 credit hours)
This course covers product development and project management for new biomedical-related products from accessing various streams of funding to allocation of resources for rapid prototyping and scale-up manufacturing. Students will visit local biotech companies and prototyping facilities. A guest lecture series will feature best practices from entrepreneurs and industry practitioners.

Prerequisite: Graduate Standing; R: Restricted to students enrolled in the M.S. Biomedical Engineering Program
Typically offered in Spring only

BME 512 Biomedical Signal Processing (3 credit hours)
Fundamentals of continuous- and discrete-time signal processing as applied to problems in biomedical instrumentation. Properties of biomedical signals and instruments. Descriptions of random noise and signal processes. Interactions between random biomedical signals and systems. Wiener filtering. Sampling theory. Discrete-time signal analysis. Applications of Z-transform and discrete Fourier transform. Digital filter design methods for biomedical instruments. Biomedical applications of filter design, signal restoration, and signal detection.

Prerequisite: BME 311, and ST 370 or ST 371
Typically offered in Spring only

BME 516/BMME 516 Advanced Drug Delivery (3 credit hours)
This course covers the engineering of novel pharmaceutical delivery systems with enhanced efficacy and safety profiles, with an emphasis on the design and application of materials that overcome drug delivery barriers or challenges. Topics will include drug delivery fundamentals and transport mechanisms, materials and formulations for drug delivery, and applications.

R: For Undergraduate students taking the course at the 500 level: BME 302 and BME 209 and CH 221; For Graduate students: Graduate standing
Typically offered in Spring only

BME 518/ECE 518/ECE 418/BME 418 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.

Prerequisite: Senior standing
Typically offered in Fall only

BME 522/ECE 522 Medical Instrumentation (3 credit hours)
Fundamentals of medical instrumentation systems, sensors, and biomedical signal processing. Example instruments for cardiovascular and respiratory assessment. Clinical laboratory measurements, theraputic and prosthetic devices, and electrical safetyrequirements. Students should have background in electronics design using operational amplifiers.

Typically offered in Spring only

BME 525/BME 425 Bioelectricity (3 credit hours)
Quantitative analysis of excitable membranes and their signals, including plasma membrane characteristics, origin of electrical membrane potentials, action potentials, voltage clamp experiments, the Hodgkin-Huxley equations, propagation, subthresholdstimuli, extracellular fields, membrane biophysics, and electrophysiology of the heart. Design and development of an electrocardiogram analysis system.

Prerequisite: BME 302 or (ZO 421 and a course in electrical circuits)
Typically offered in Spring only

BME 540 Nanobiotechnology Processing, Characterization, and Applications (3 credit hours)
Topics at the interface of nanoscale science and biotechnology will be discussed. Chemical, physical, and biological properties of nanostructured biomaterials, devices, and systems. Lectures and problem-based learning will be used to present development of nanobiotechnology-enhanced materials and devices.

Prerequisite: BIO 183 and PY 212
Typically offered in Spring only

BME 544/BME 444 Orthopaedic Biomechanics (3 credit hours)
Students study human body kinematics, force analysis of joints, and the structure and composition of biological materials. Emphasis is placed on the measurement of mechanical properties and the development and understanding of models of biological material mechanical behavior.

P: BM(M)E 301, BM(M)E 302, [BM(M)E 345 or MAE 214 or CE 313]
Typically offered in Fall only

BME 551 Medical Device Design (3 credit hours)
Student multidisciplinary teams work with local medical professionals to define specific medical device concepts for implementation. Medical specialty immersion with clinical departments at local medical centers; design input based on stakeholder-needs assessment' market analysis and intellectual property review; new medical devices with broad markets; design output and device specification; product feasibility and risk assessment; design for medical device manufacturing.

Typically offered in Fall only

BME 560/BMME 560 Medical Imaging: X-ray, CT, and Nuclear Medicine Systems (3 credit hours)
Overview of medical imaging systems using ionizing radiation. Interaction of radiation with matter. Radiation production and detection. Radiography systems and applications. Tomography. PET and SPECT systems and applications.

Prerequisite: BME 311, ST 370 or ST 371, and PY 208

BME 566/TE 466/BME 466/TE 566 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioresorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)
Typically offered in Fall only

BME 570 ImmunoEngineering (3 credit hours)
The immune system influences nearly all aspects of human health and therefore deserves consideration by investigators developing devices, drugs and strategies to improve human health. The course begins with a brief review of the immune system, fundamental immunological assays and the role of the immune system in disease. The second part of the course focuses on immune responses to a range of biomaterials. The third part will explore immune responses in the context of vaccines, immunotherapies and regenerative medicine.

P: Graduate Standing
Typically offered in Spring only

BME 571 Intro to Nano-Biomaterials (3 credit hours)
Chemical, physical, biological, and engineering aspects of nanostructured materials used in medical implants.

Prerequisites: Introduction to the Materials Science of Biomaterials (BME (MSE) 203), Human Physiology for Engineers I (BME 301) and Human Physiology for Engineers II (BME 302). Equivalent courses accepted at discretion of instructor.
Typically offered in Spring and Summer

BME 583/BEC 583/BME 483/BEC 483 Tissue Engineering Technologies (2 credit hours)
In this half-semester laboratory module, students will gain practical experience with two key elements of tissue engineering: tissue building and angiogenesis. Using advanced culture techniques, students will construct a complex living tissue that closely resembles its natural counterpart, then assess its ability to support ingrowth of capillaries (angiogenesis). The effects of different biomaterials and angiogenic factors will be evaluated. The engineered tissue will be embedded, sectioned and stained for histological analysis.

Prerequisite: BIT 466/566 or permission of instructor
Typically offered in Fall only

BME 584/BME 484 Fundamentals of Tissue Engineering (3 credit hours)
This course covers essential concepts of organ and tissue design and engineering using living components, including cell-based systems and cells/tissues in combination with biomaterials, synthetic materials and/or devices. Topics include: In vivo tissue structure and function; Isolation and culture of primary cells and stem cells; Principles of cellular differentiation; Mass transport processes in cell culture systems; Design, production and seeding of scaffolds for 3D culture; Design of bioreactors to support high-density cell growth; State-of-the-art engineered tissue systems; Clinical translation; and Ethics.

Prerequisite: BIO 183, CH 221, and (MAE 201 or MSE 301 or CHE 315 or TE 303 or BME 315 or BME 325)
Typically offered in Spring only

BME 590 Special Topics in Biomedical Engineering (1-6 credit hours)
A study of topics in the special fields under the direction of the graduate faculty.

Prerequisite: Senior or Graduate standing in Engineering or physical or biological sciences or textiles
Typically offered in Fall, Spring, and Summer

BME 650 Internship in Biomedical Engineering (1 credit hours)
Students obtain professional experience through advanced engineering work in industrial and commercial settings under joint supervision of a member of the graduate faculty and an outside professional.

Prerequisite: Graduate standing in BME
Typically offered in Summer only

BME 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

BME 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BME 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BME 790 Advanced Special Topics in Biomedical Engineering (1-6 credit hours)
A study of topics in advanced or emerging special areas under the direction of the graduate faculty. Experimental doctoral level courses.

Prerequisite: Graduate standing in engineering, physical, or biological sciences or textiles
Typically offered in Fall, Spring, and Summer

BME 802 Advanced Seminar in Biomedical Engineering (1 credit hours)
Elaboration of advanced subject areas, techniques and methods related to professional interest through presentations of personal and published works; opportunity for students to present and critically defend ideas, concepts, and inferences; opportunity for distinguished scholars to present results of their work. Discussions to uncover analytical solutions and analogies between problems in biomedical engineering and other technologies, and to present relationship of biomedical engineering to society.

Prerequisite: Doctoral student in BME or other engineering, physical science, or biological science majors, or textiles
Typically offered in Fall and Spring

BME 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning but the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BME 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

BME 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

BME 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

BME 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Bioprocessing (BBS)

BBS 201 Introduction to Biopharmaceutical Science (3 credit hours)
Through this course, students will experience laboratory and manufacturing terminology relevant to the biomanufacturing industries. Students will also gain exposure to regulatory and compliance procedures and issues facing this industry. This coursewill provide an introduction to prepare students to meet the demands and expectations of this industry and the bioprocessing science program.

Typically offered in Spring only

BBS 301 Process Validation Science (3 credit hours)
Process validation is a tested and documented subset of the panel of activities that are performed during the production of a biopharmaceutical. This course will introduce the concept of process validation as it applies to the biotechnology industry, and more specifically, to the manufacture of protein molecules as therapeutic agents.

Prerequisite: (FS 231 and BBS 201) or BBS 426.
Typically offered in Fall only

BBS 325/FS 325 Introduction to Brewing Science and Technology (3 credit hours)
For centuries brewing has been and remains a vitally important application of fermentation science, both economically and socially. This course will provide a detailed description of the fundamental chemical and biological processes involved in brewing beer, as well as the physical and hygienic aspects of modern beer production. Successful completion of this course will provide students with the understanding of the science and technology underlying the key steps in a commercial brewing process and provide the basic knowledge necessary for an entry level position in a commercial brewery.

Prerequisite: CH 101 and BIO 183 or BIO 181
Typically offered in Spring only

BBS 326/FS 326 Brewing Practices and Analyses (3 credit hours)
This course will provide a hands on learning experience to both complement the classroom lectures offered in BBS/FS 325 and acquaint the student with the equipment and practices encountered in real-world analytical labs of breweries of all scales. The laboratory experience will replicate the sequence of events encountered in actual beer production and illustrate the relevant evaluations and analyses which are concurrent with those processing steps, stressing at each stage not only the execution of the appropriate analytical or testing techniques, but also corrective action that may be taken should undesirable results be obtained.

Prerequisite: BBS/FS 325 Introduction to Brewing Science and Technology
Typically offered in Fall only

BBS 426/FS 426/BEC 426/BBS 526/FS 526/BEC 526 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

BBS 427/FS 427 Brewing Equipment, Controls and Operations (3 credit hours)
Modern commercial brewing is an equipment and utility intensive endeavor. Emphasis on efficiency, flexibility and sanitation has led to equipment and controls which have vastly improved the volume and consistency of brewery output while also improving safety and the quality of the working environment. In order to manage the transfer of material and energy in the brewing process, individual components within the brewing system, as well holistic function of the brewery environment have been adapted to maximize efficiency. Knowledge of the specific design and operation of these components within the overall system is crucial to the proper functioning of a brewery. The operation of individual components and processes within the brewery will be examined in terms of the physics and engineering principles driving their function. On completion, this course will provide sufficient knowledge of brewery equipment and operations to function successfully in an entry to mid-level position.

Corequisite: BBS 325 or FS 325
Typically offered in Spring only

BBS 526/FS 526/BEC 526/BBS 426/FS 426/BEC 426 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

Biotechnology (BIT)

BIT 100 Current Topics in Biotechnology (4 credit hours)
This course provides both science and non-science students an opportunity to learn about current issues in biotechnology that play a role in our society. Topic areas will include contemporary and historical applications of biotechnology. From alternative fuel sources to the ramifications of the elucidation of the human genome on health care issues, advances in biotechnology are constantly reshaping the world we live in. Students will give presentations and participate in discussions in the classroom, as well as be engaged in the laboratory on a variety of different topics in biotechnology that affects all our lives.

Prerequisite: High School Biology
GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall only

BIT 200 Early Research in Biotechnology (4 credit hours)
This course offers first-and second-year students an opportunity for a mentored research experience in a small class environment. Students will learn how to apply the scientific method to make new discoveries and contribute to scientific knowledge. Students may need to come to the lab outside class meeting times to complete work on occasion (flexible hours). Examples of research questions to be investigated in different sections: - Investigating bacteriophage for the management of American Floubrood Disease (AFS) of honey bees - Using planarian as a model system for studying genes important in stem cell differentiation and regeneration - Investigating the genetic potential of complex microbial populations. - Gene expression profiling in zebrafish embryos exposed to antibiotics and anti-acne compounds Freshmen and Sophomores only.

Prerequisite: High School Biology
GEP Natural Sciences
Typically offered in Fall and Spring

BIT 210/MB 210 Phage Hunters (3 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will isolate and characterize naturally-occurring bacteriophage (viruses that infect bacteria, but not humans) from the environment. They will present their data to each other, and the genome of one phage will be sequenced. Students have the option to continue in a second semester to annotate that genome, culminating in a submission to genbank and a poster presentation. Students in the course are part of the National Genome Research Initiative funded by The Howard Hughes Medical Institute. Student should have had a high school biology course before taking this course.

GEP Natural Sciences
Typically offered in Fall only

BIT 211/MB 211 Phage Genomics (2 credit hours)
This course offers first-year students an opportunity for mentored research. Student will apply the scientific method to make novel discoveries. Students will build on the work they began in BIT/MB 210; The novel phage isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to analyze and annotate the genome sequence. This semester will culminate in a submission to genbank and a poster presentation. Students in the course are part of the national genome research initiative funded by the Howard Hughes Medical Institute.

Prerequisite: BIT(MB) 210
GEP Natural Sciences
Typically offered in Spring only

BIT 295 Special Topics in Biotechnology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BIT 402/BIT 502 Biotechnology Networking and Professional Development (1 credit hours)
This course provides students interested in the biotechnology field an opportunity to gain valuable network, job application and interviewing skills. Over the course of the semester students will meet with ~30 biotechnology professionals in our area. In addition, students will learn from individuals in biotechnology jobs about the diverse careers options available and strategies for navigating the job market successfully.

Typically offered in Spring only

BIT 410 Manipulation of Recombinant DNA (4 credit hours)
Introduction to molecular biology and protein chemistry. Theory behind laboratory techniques and overview of cloning strategies starting from nucleic acid or protein sequence data. Laboratory sessions involve subcloning, preparation of competent cells, transformation, screening recombinant DNA by colony hybridization and PCR, SDS-PAGE of recombinant protein, affinity purification, and western blots.

Prerequisite: BIO 183 or ZO/BIO 160 and CH 223 or CH 227 with a C- or better
Typically offered in Fall, Spring, and Summer

BIT 463/CHE 463/BEC 463/BIT 563/CHE 563/BEC 563 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

BIT 464/BIT 564 Protein Purification (2 credit hours)
Comparison of several different chromatography techniques for protein purification. Construction of purification tables and SDS-and native-PAGE analysis. Cost-benefit analysis of industrial-scale procedures. Half semester course, second part.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 465/BIT 565 Real-time PCR Techniques (2 credit hours)
Real time PCR is an evolving technique with its basis in the dynamic properties of the polymerase chain reaction and fluorescent detection. We will review current real-time theory, techniques, machinery, troubleshooting, tools, and advanced protocols for sequence detection including SYBR green, TaqMan, Beacons, multiplexing, and single nucleotide polymorphism analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment. At the conclusion of this course, students should feel comfortable with real-time experimental design, its tools, and analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 466/BIT 566 Animal Cell Culture Techniques (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.

Typically offered in Fall, Spring, and Summer

BIT 467/BIT 567 PCR and DNA Fingerprinting (2 credit hours)
Introduction to polymerase chain reaction. Optimization of PCR reactions and primer design for DNA sequences using DNA databases available on the web. Laboratory sections include using rapid techniques for isolating and sequencing DNA from small amounts of sample and forensic identification of individuals using isolated human hairs. Credit is not allowed for both BIT 467 and BIT 567.

Prerequisite: BIT 410/510
Typically offered in Spring only

BIT 471/BIT 571 RNA Interference and Model Organisms (2 credit hours)
Introduction and history of RNA interference technology. Principles, mechanism, and applications of RNA interference in model organisms. Laboratory sessions include RNA interference-mediated silencing of genes in plants, C. elegeans, and mammalian cell culture. This is a half-semester course (8 weeks). Student may not earn credit for both BIT 471 and BIT 571.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 473/BIT 573 Protein Interactions (2 credit hours)
The interactions of proteins mediate numerous biological processes of cells. This course focuses on ways to identify and study protein-protein interactions, focusing on the advantages and limitations of each technique and how to apply the methods in a laboratory setting. In lab, students will perform a yeast two-hybrid experiment and a co-immunoprecipitation from proteins expressed in mammalian cell culture to confirm detected interactions. This a half-semester course.

Prerequisite: BIT 410 or BCH 454
Typically offered in Fall only

BIT 474/BIT 574 Plant Genetic Engineering (2 credit hours)
This course covers fundamental hands-on techniques and strategies in plant genetic engineering. Plants are major sources of food, fiber and fuel and provide model systems for both fundamental and applied research. Students will learn techniques for stable and transient transformation of plants and plant cell cultures and selection and detection of transgene expression. Additional topics covered will include methods to generate and screen for mutants, synthetic biology and applications of plant genetic engineering. This is a half-semester course. Credit is not allowed for both BIT 474 and BIT 574.

Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421
Typically offered in Fall only

BIT 476 Applied Bioinformatics (2 credit hours)
The haploid human genome occupies a total of just over 3 billion DNA base pairs. This information is not contained in books, but stored in electronic databases. Computational biology utilizes infer function by comparative analysis. This course is designed for life scientists from all fields to introduce them to the power of bioinformatics and enable them to access and utilize biological information in databases for their own research.

Prerequisite: BIT 410 or BCH 454 or GN 311
Typically offered in Fall only

BIT 477/BIT 577 Metagenomics (2 credit hours)
Participants will be introduced to a variety of methods for studying the complex microbial populations that surround us, including theory, applications, limitations, and health and legal implications. Students will apply deep sequencing techniques to mine the genetic diversity of complex microbial populations such as the rhizosphere, a swine lagoon sample, or even the communities of microbes growing happily inside your kitchen sink drain. This course will provide hands-on experience with molecular and computational tools that can be used to study the relationships between microbial communities and ecosystems or hosts.

Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 479/BIT 579 High-Throughput Discovery (2 credit hours)
In this eight-week lab module, participants will be introduced to high-throughput (HT) discovery science and the underlying quantitative biology skills necessary for robust assay design. Participants will learn modern high-throughput screening approaches that will prepare them to design, validate, and perform cutting-edge screens. Different HT approaches will be discussed using authentic case studies and critical thinking scenarios based on published studies. Essential quantitative biology skills for the design and analysis of HT discovery science will be emphasized and tested regularly using "biomath" quizzes. The power of automation and robotics will be highlighted and hands-on experience with a liquid handler and the software used to operate it will be routine in the lab sessions. Participants will also be exposed to novel high-throughput approaches through discussions of new technologies and guest speakers who are experts in the field. Students will not receive credit for both BIT 479 and BIT 579.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 480/BIT 580 Yeast Metabolic Engineering (2 credit hours)
Participants will be introduced to a variety of methods for using yeast to produce commercially relevant products. Topics will include cultivation, genetic manipulation to delete or replace genes, transformation, heterologous gene expression and codon optimization/gene synthesis. Various modern molecular cloning approaches and computational resources will be discussed. Students will apply gene manipulation approaches to engineer Saccharomyces cerevisiae to produce beta-carotene and/or other relevant biotechnology products. This will be accomplished by assembling a series of optimized genes in the biosynthetic pathway using the versatile genetic assembly system (VEGAS) that exploits the capacity of Saccharomyces cerevisiae to join sequences with terminal homology by homologous recombination. Expression will be compared by assembling libraries of transcriptional units with different promoters and using different genetic knock-outs as hosts. Additionally, computational modeling of metabolic processes will be used to assess perturbations to metabolic fluxes.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 481/PB 481 Plant Tissue Culture and Transformation (2 credit hours)
Basic techniques in plant tissue culture and transformation. Empirical approaches to techniques in plant tissue culture, designing transgenes for expression in specific plant cell organelles and tissues, use of reporter genes to optimize transformation, and troubleshooting transformation. Laboratory sessions provide hands-on experience with plant tissue culture and transformation. Use of reporter genes, fluorescence microscopy and digital imaging. Half semester course, first part.

Typically offered in Spring only

BIT 482/BIT 582 Virus Biotechnology: Pathogens to Therapeutics (2 credit hours)
In this course, students will be introduced to concepts spanning principles in molecular virology through to engineering of viruses as molecular therapeutics. Students will be able to describe the basic tenets of molecular virology, articulate several principle uses of viruses in biotechnology applications, and perform data analysis on several fundamental virus assays.

Prerequisite: BIT 410
Typically offered in Fall and Spring

BIT 492 External Learning Experience (1-6 credit hours)
A learning experience in the area of biotechnology within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, and the departmental teaching coordinator prior to the experience. Project must be approved by the Academic Coordinator or Program Director of the Biotechnology Program.

Typically offered in Summer only

BIT 493 Special Problems in Biotechnology (1-6 credit hours)
A learning experience within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective mentor(s) must be initiated by student and approved by a faculty adviser, the prospective mentor, and the departmental teaching coordinator prior to the experience. Project must be approved by the Academic Coordinator of Program Director of the Biotechnology Program.

Typically offered in Fall, Spring, and Summer

BIT 495 Special Topics in Biotechnology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BIT 501 Ethical Issues in Biotechnology (1 credit hours)
Students investigate and discuss current controversial issues in biotechnology. This course emphasizes thinking about new technologies in a rational and thoughtful way.

Typically offered in Fall and Spring

BIT 502/BIT 402 Biotechnology Networking and Professional Development (1 credit hours)
This course provides students interested in the biotechnology field an opportunity to gain valuable network, job application and interviewing skills. Over the course of the semester students will meet with ~30 biotechnology professionals in our area. In addition, students will learn from individuals in biotechnology jobs about the diverse careers options available and strategies for navigating the job market successfully.

Typically offered in Spring only

BIT 510 Core Technologies in Molecular and Cellular Biology (4 credit hours)
Basic technologies of recombinant DNA procedures, gene expression, isolation and identification of nucleic acids and proteins.

Prerequisite: Equivalent of CH 223 and (MB 351 or GN 311)
Typically offered in Fall, Spring, and Summer

BIT 563/CHE 563/BEC 563/BIT 463/CHE 463/BEC 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

BIT 564/BIT 464 Protein Purification (2 credit hours)
Comparison of several different chromatography techniques for protein purification. Construction of purification tables and SDS-and native-PAGE analysis. Cost-benefit analysis of industrial-scale procedures. Half semester course, second part.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 565/BIT 465 Real-time PCR Techniques (2 credit hours)
Real time PCR is an evolving technique with its basis in the dynamic properties of the polymerase chain reaction and fluorescent detection. We will review current real-time theory, techniques, machinery, troubleshooting, tools, and advanced protocols for sequence detection including SYBR green, TaqMan, Beacons, multiplexing, and single nucleotide polymorphism analysis. Students will have the opportunity to utilize skills learned during lecture in a laboratory environment. At the conclusion of this course, students should feel comfortable with real-time experimental design, its tools, and analysis of generated data. This is a half-semester course. Student must register for both lecture and lab sections.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 566/BIT 466 Animal Cell Culture Techniques (2 credit hours)
Introduction to animal cell culture techniques. Aseptic technique for vertebrate cell culture, media formulation, primary cell culture, long-term maintenance of cell lines, application of molecular techniques to in vitro situations. Half semester course, first part.

Typically offered in Fall, Spring, and Summer

BIT 567/BIT 467 PCR and DNA Fingerprinting (2 credit hours)
Introduction to polymerase chain reaction. Optimization of PCR reactions and primer design for DNA sequences using DNA databases available on the web. Laboratory sections include using rapid techniques for isolating and sequencing DNA from small amounts of sample and forensic identification of individuals using isolated human hairs. Credit is not allowed for both BIT 467 and BIT 567.

Prerequisite: BIT 410/510
Typically offered in Spring only

BIT 571/BIT 471 RNA Interference and Model Organisms (2 credit hours)
Introduction and history of RNA interference technology. Principles, mechanism, and applications of RNA interference in model organisms. Laboratory sessions include RNA interference-mediated silencing of genes in plants, C. elegeans, and mammalian cell culture. This is a half-semester course (8 weeks). Student may not earn credit for both BIT 471 and BIT 571.

Prerequisite: BIT 410 or BIT 510 or BCH 454
Typically offered in Spring only

BIT 572/BIO 572/CH 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.

Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

BIT 573/BIT 473 Protein Interactions (2 credit hours)
The interactions of proteins mediate numerous biological processes of cells. This course focuses on ways to identify and study protein-protein interactions, focusing on the advantages and limitations of each technique and how to apply the methods in a laboratory setting. In lab, students will perform a yeast two-hybrid experiment and a co-immunoprecipitation from proteins expressed in mammalian cell culture to confirm detected interactions. This a half-semester course.

Prerequisite: BIT 410 or BCH 454
Typically offered in Fall only

BIT 574/BIT 474 Plant Genetic Engineering (2 credit hours)
This course covers fundamental hands-on techniques and strategies in plant genetic engineering. Plants are major sources of food, fiber and fuel and provide model systems for both fundamental and applied research. Students will learn techniques for stable and transient transformation of plants and plant cell cultures and selection and detection of transgene expression. Additional topics covered will include methods to generate and screen for mutants, synthetic biology and applications of plant genetic engineering. This is a half-semester course. Credit is not allowed for both BIT 474 and BIT 574.

Prerequisite: BIT 410 or BIT 510 or BCH 454 or PB 421
Typically offered in Fall only

BIT 577/BIT 477 Metagenomics (2 credit hours)
Participants will be introduced to a variety of methods for studying the complex microbial populations that surround us, including theory, applications, limitations, and health and legal implications. Students will apply deep sequencing techniques to mine the genetic diversity of complex microbial populations such as the rhizosphere, a swine lagoon sample, or even the communities of microbes growing happily inside your kitchen sink drain. This course will provide hands-on experience with molecular and computational tools that can be used to study the relationships between microbial communities and ecosystems or hosts.

Prerequisite: BIT 410 or 510
Typically offered in Fall only

BIT 579/BIT 479 High-Throughput Discovery (2 credit hours)
In this eight-week lab module, participants will be introduced to high-throughput (HT) discovery science and the underlying quantitative biology skills necessary for robust assay design. Participants will learn modern high-throughput screening approaches that will prepare them to design, validate, and perform cutting-edge screens. Different HT approaches will be discussed using authentic case studies and critical thinking scenarios based on published studies. Essential quantitative biology skills for the design and analysis of HT discovery science will be emphasized and tested regularly using "biomath" quizzes. The power of automation and robotics will be highlighted and hands-on experience with a liquid handler and the software used to operate it will be routine in the lab sessions. Participants will also be exposed to novel high-throughput approaches through discussions of new technologies and guest speakers who are experts in the field. Students will not receive credit for both BIT 479 and BIT 579.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 580/BIT 480 Yeast Metabolic Engineering (2 credit hours)
Participants will be introduced to a variety of methods for using yeast to produce commercially relevant products. Topics will include cultivation, genetic manipulation to delete or replace genes, transformation, heterologous gene expression and codon optimization/gene synthesis. Various modern molecular cloning approaches and computational resources will be discussed. Students will apply gene manipulation approaches to engineer Saccharomyces cerevisiae to produce beta-carotene and/or other relevant biotechnology products. This will be accomplished by assembling a series of optimized genes in the biosynthetic pathway using the versatile genetic assembly system (VEGAS) that exploits the capacity of Saccharomyces cerevisiae to join sequences with terminal homology by homologous recombination. Expression will be compared by assembling libraries of transcriptional units with different promoters and using different genetic knock-outs as hosts. Additionally, computational modeling of metabolic processes will be used to assess perturbations to metabolic fluxes.

Prerequisite: BIT 410 or 510
Typically offered in Spring only

BIT 581 Plant Transformation (2 credit hours)

BIT 582/BIT 482 Virus Biotechnology: Pathogens to Therapeutics (2 credit hours)
In this course, students will be introduced to concepts spanning principles in molecular virology through to engineering of viruses as molecular therapeutics. Students will be able to describe the basic tenets of molecular virology, articulate several principle uses of viruses in biotechnology applications, and perform data analysis on several fundamental virus assays.

Prerequisite: BIT 410
Typically offered in Fall and Spring

BIT 590 Independent Study in Biotechnology (1-3 credit hours)
Independent study in Biotechnology under the supervision of a Biotechnology faculty member. Restricted to graduate students in the Biotechnology Program with consent of the supervising faculty. May not be taken in the first semester of graduate study.

Typically offered in Fall, Spring, and Summer

BIT 595 Special Topics (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BIT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Master's students only
Typically offered in Fall and Spring

BIT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

BIT 790 Independent Study in Biotechnology (1-3 credit hours)
Independent study in Biotechnology under the supervision of a Biotechnology faculty member. Restricted to graduate students in the Biotechnology Program with consent of the supervising faculty. May not be taken in the first semester of graduate study.

Typically offered in Fall, Spring, and Summer

BIT 815 Advanced Special Topics (1-6 credit hours)
Intensive three-week or six-week courses in advanced technologies such as DNA sequencing, downstream processing, immunological techniques, construction of c-DNA libraries, mammalian embryo manipulation, plant transformation, bioreactor design, cloning in gram positive bacteria, electron microscopy or techniques in yeast molecular biology.

Prerequisite: BIT 510
Typically offered in Summer only

BIT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Doctoral students only (DR)
Typically offered in Fall and Spring

Business Administration (MBA)

MBA 501 Financial Accounting for Decision Makers (1 credit hours)
Methods used by accountants record to economic events such as operating, investing, and financing activities, in the income statement, balance sheet, and statement of cash flows. Analysis of financial statements and disclosures. Impact of accounting standards and managerial incentives on the financial reporting process. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 502 Managerial Accounting for Decision Makers (1 credit hours)
Foundational knowledge in managerial accounting for decision making. Internal uses of accounting information for decision making within the organization. Identification of revenue and cost information to conduct break-even analyses, assign product costs, complete operational budgets, assess performance, and complete other management decision-making processes. Restricted to MBA students.

Prerequisite: MBA 501
Typically offered in Fall, Spring, and Summer

MBA 505 Essential Economics for Managers (2 credit hours)
Survey of economic concepts applied to management decisions. Competition. Market power. The firm, production, and cost. Pricing practices. Output. Market success. Market failure. Restricted to MBA students.

Typically offered in Fall and Spring

MBA 506 Data-Driven Managerial Decisions 1 (1 credit hours)
Business cases and problems where data analysis is part of the decision-making process. Applications to finance, management, marketing, and operations. Proficiency in Excel methods commonly used in management. Completion of a project where students follow a business problem from formulation to solution using data analysis. Restricted to MBA students.

Prerequisite: BUS/ST 350
Typically offered in Fall, Spring, and Summer

MBA 507 Data-Driven Managerial Decisions 2 (1 credit hours)
Continuation of a series of business cases and problems where data analysis is part of the decision making process. Estimation of linear relationships among variables, with applications to finance, management, marketing, and operations. Proficiency with Excel methods commonly used for estimation. Completion of a project where students follow a business problem from formulation to solution using the methods covered the course. Restricted to MBA students.

Prerequisite: MBA 506
Typically offered in Fall and Spring

MBA 510 Critical Thinking for Managers (1 credit hours)
Structure for critically analyzing and evaluating an issue, claim, text, or speech from a management perspective. Systematic analysis and evaluation of information, concepts, and ideas in order to identify underlying assumptions, purposes, and questions. Synthesis of this knowledge to logically form conclusions and recognize implications. Communication of arguments and beliefs and recognition of common language barriers in the written and spoken word. For online sections, must be enrolled in MBA program.

Typically offered in Fall and Spring

MBA 511 Data Security and Privacy (3 credit hours)
Data security and privacy necessary for todayÃ¿s business environment. Common vulnerabilities, securing data, encryption, policies, privacy management, standards, and compliance.

Typically offered in Fall and Spring

MBA 512 Ethical Thinking for Managers (1 credit hours)
This course provides students a foundation for thinking through business issues from an ethical perspective. Students will advance their skills for recognizing and reasoning through ethical dilemmas in management, with an aim toward developing essential ethical traits including integrity, empathy, courage, fairmindedness,autonomy. perseverance, humility, and confidence in reason. Students will apply a structured, reasoned process for resolving ethical dilemmas, and will engage in personal reflection to continue to develop their intellectual traits.

Restriction: MBA Students Only; MBA 510 (Critical thinking for managers) is a required prereq.
Typically offered in Fall and Spring

MBA 515 Enterprise Resource Planning Systems (3 credit hours)
Market and evolution of enterprise resource planning (ERP) systems and ERP technology. Business process reengineering in sales, purchasing, human capital, accounting, plant maintenance and warehousing using SAP Security issues. Course can lead to SAP University Alliance Recognition.

Typically offered in Fall and Spring

MBA 518 Enterprise Risk Management (3 credit hours)
Integrated approach to managing the risks that can prevent an organization from achieving its objectives, both financial and non-financial. Core elements of an effective enterprise risk management process. Links to management strategy. Risk assessment methodologies.

Typically offered in Fall only

MBA 519 Enterprise Risk Management Practicum (3 credit hours)
Applied approach to managing the risks that can prevent an organization from achieving its objectives, both financial and nonfinancial, by working in teams to address real problems in real organizations.

Prerequisite: MBA 518
Typically offered in Spring only

MBA 520 Financial Management of Corporations (2 credit hours)
Financial decision making at profit-motivated businesses: decisions about what to produce and how and decisions about how to finance the assets needed for production. Cash as the basis of asset valuation. Capital budgeting decisions under certainty and uncertainty. Capital market theory. Cost of capital. Bond and stock valuation. Restricted to MBA students.

Prerequisite: MBA 501 Financial Accounting for Decision Makers
Typically offered in Fall, Spring, and Summer

MBA 521 Advanced Corporate Finance (3 credit hours)
Overview of financial management. Evaluation of projects and valuation of real assets using traditional discounted cash flow analysis and real options. Role of financial leverage; optimal capital structure. Conflicts between security holders and management; stockholder-bondholder conflicts; financial distress, bankruptcy and reorganization; corporate control and restructuring; corporate governance issues.

Prerequisite: MBA 520
Typically offered in Fall and Spring

MBA 522 Financial Modeling (3 credit hours)
This course examines models for capital budgeting, equity and bond valuation, capital structure, dividend policy, among other topics, using spreadsheet analyses. The course will take a very hands-on approach in building spreadsheet models. The course also includes sensitivity analysis, pro-forma analysis and using financial statements.

Prerequisite: MBA 520
Typically offered in Fall only

MBA 523 Investment Theory and Practice (3 credit hours)
Advanced topics in investments with a focus on underlying theory and practical application using real world data. Stock valuation models, bond valuation, derivatives, portfolio performance evaluation, investment strategies, efficient market theory and other current issues in investment finance.

Prerequisite: MBA 520
Typically offered in Fall and Spring

MBA 524 Equity Valuation (3 credit hours)
Advanced quantitative course on applied equity valuation. Students conduct stock valuation analysis which is then used to select stocks for the student-managed SunTrust MBA fund. Topics include the investment decision making process, empirical evidence on securities returns, forecasting financial statements, industry and macro-economic analysis, valuation models, portfolio performance evaluation and performance attribution. Students will also learn how to write computer programs using SAS software in order to generate statistical tests of investment strategies using "big financial data.

Prerequisite: MBA 520
Typically offered in Spring and Summer

MBA 525 Taxes and Business Strategy (3 credit hours)
Importance of tax consideratoins in business decisions. Framework for understanding how taxes affect business strategy and financing decisions in a wide variety of settings.

Typically offered in Spring only

MBA 526 International Finance (3 credit hours)
Theory and practice of financial management in the international arena, including spot and forward markets for foreign exchange, currency futures and options contracts, international arbitrage conditions, foreign exchange exposure, foreign trade financing instruments, direct and portfolio investment abroad, and the role of country risk in determining investments.

Prerequisite: MBA 520
Typically offered in Fall only

MBA 530 Leading People (3 credit hours)
This course is about the fundamentals of leading people, a critical aspect of every management position and leadership role. The course will focus at three levels of analysis: the individual, the group and the organization. Students will gain exposure to topics and issues in the field of organizational behavior and human resource management. These include knowing about and dealing with individual differences, international and cultural issues, working in groups (both virtually and geographically co-located), motivation, leadership, organizational structures and cultures, change management, empowerment, delegation, communication, and management ethics. Restricted to MBA students.

Typically offered in Spring only

MBA 531 Leading People 1 (1 credit hours)
This one-credit course is designed for part-time and online students and serves as the first part of the Leading People series. The Leading People series focuses at three levels of analysis: the individual, the group and the organization. In this series, students will gain exposure to topics and issues in the field of organizational behavior and human resource management. Content covered in part 1 addresses team leadership and change management. This course also includes instruction on improving communication skills, making presentations, leading from strengths, and emotional intelligence. Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 531.

Restriction: Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 531.
Typically offered in Fall and Spring

MBA 532 Leading People 2 (2 credit hours)
This two-credit course is designed for part-time and online students and serves as the second part of the Leading People series. The Leading People series focuses at three levels of analysis: the individual, the group and the organization. Students will gain exposure to topics and issues in the field of organizational behavior and human resource management. Content covered in this course includes dealing with individual differences, international and cultural issues, working in groups (both virtually and geographically co-located), motivation, leadership, organizational structures and cultures, empowerment, delegation, and management ethics. Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 532.

Restriction: Restricted to MBA students. Students may not receive credit in MBA 530 and MBA 532.
Typically offered in Spring and Summer

MBA 533 Negotiation and Conflict Management (3 credit hours)
Course emphasizes ensuring that the organization benefits from inevitable conflicts that occur. It provides skills in diagnosis, negotiation, and building trust and cooperative working relationships in organizations.

Typically offered in Fall only

MBA 534 Core Concepts of Human Capital Management (3 credit hours)
The course will cover the core concepts behind successfully acquiring, deploying and motivating talent to achieve organization competitiveness. Students will think strategically about company human assets, learn basic HRM concepts and then create practical solutions to typical HCM problems. At the end of this course, students will demonstrate a basic understanding of the topics of equal opportunity employment, diversity, recruiting and selection, performance evaluation, performance goal setting, performance coaching and feedback, competitive compensation and benefits, fair discipline and termination processes and strategic talent management and succession programs.

Typically offered in Fall only

MBA 535 Leading Teams (1 credit hours)
More and more organizations are using team-based work to accomplish tasks. This course provides the latest, evidence-based best practices for working in, and leading, teams in organizations. The course is designed to be activity-driven and hands-on to give students the opportunity to practice and improve their team skills.

Typically offered in Fall only

MBA 536 Experience Innovation and Strategic Design (3 credit hours)
Successful innovation involves creating more valuable experiences for users and customers. The course covers key concepts and methodologies for experience-based innovation, drawing on design and creativity frameworks to fully understand customer experiences. Course activities include exercises and a project to practice innovation and "design-thinking" tools and techniques in a business context. Relevant strategic perspectives for designing innovative products and services are addressed through case studies and other managerial readings with practical business application. The importance of a multi-disciplinary approach to experience innovation is emphasized, such that the course is suitable for students in all disciplines with an interest in innovation.

Typically offered in Spring only

MBA 538 Women as Leaders (1 credit hours)
This course focuses on helping women uncover and reflect on their leadership styles so that they can become more empowered leaders, take responsibility for recognizing the potential in people and ideas, and have the courage to develop that potential.

Typically offered in Spring only

MBA 539 Jenkins Leadership Challenge (1 credit hours)
Leadership skills are highly valued in today's business environment. This is the capstone course for the Jenkins MBA Leadership Certificate. In other classes in the leadership series, students have learned what a successful leader is, what a successful leader does, and how a successful leader deals with contingencies in an effective way. In this class participants will review the Five Practices of Exemplary Leadership and select behaviors in their own leadership practice that need to be adjusted for stronger leadership performance. Students will then plan and execute a personal leadership challenge to address these behaviors. Course content includes a leadership assessment, lectures and readings, required participation in group coaching, periodic individual reflections, development of videos for leadership challenge proposals and testimonials, and a final paper that reflects on the student's journey through the leadership program and identifies plans for the future.

Prerequisite: MBA 510 and MBA 530 or MBA 531 and MBA 532.
Typically offered in Fall and Spring

MBA 540 Principles of Operations and Supply Chain Management (2 credit hours)
Design and management of operations and supply chains. Analysis of strategies, processes, planning and control, and advanced techniques using a variety of managerial frameworks and quantitative tools. Restricted to MBA students.

Prerequisite: MBA 507
Typically offered in Fall and Spring

MBA 541 Supply Management (3 credit hours)
Major themes and strategies of supply management relationships. The focus is on establishing a basis for collaborative relationships with suppliers through focused market intelligence research, relationship assessment and management, negotiation, collaborative contracting, and on-going management of relationships in global supply chains. Emphasis on the importance of collaboration through the application of practical tools and approaches that drive mutually beneficial outcomes. Core processes around initial exploration and assessment of supply chain relationships, establishing metrics/expectations for the relationship, crafting and managing contracts, and sustaining continuous performance improvement in sourcing, logistics and operations. Every student will participate in a team-based supply chain project with an organization and will learn the team-based, deadline-driven nature of supply chain initiatives in a real-company setting.

Co-requisite: MBA 540 Operations and Supply Chain Management
Typically offered in Fall and Spring

MBA 542 Supply Chain Logistics (3 credit hours)
Effective logistics decision-making using a variety of conceptual frameworks and quantitative tools. Relationship between logistics and broader issues of managing the entire supply chain and fulfilling the strategic objectives of a firm. Inventorymanagement. Transportation. Network design.

Typically offered in Fall and Spring

MBA 543 Planning and Control Systems (3 credit hours)
Design and management of planning and control systems within the organization and across the supply chain. Business planning, master production scheduling, material requirements planning, just-in-time and theory of constraints. Enterprise resourceplanning (ERP) and business-to-business (B2B) systems. Impact of information technologies on planning and control systems. Major project using state-of-the-art ERP system.

Typically offered in Spring only

MBA 545 Decision Making under Uncertainty (3 credit hours)
Structured framework for modeling and analyzing business decisions in the presence of uncertainty and complex interactions among decision parameters. Topics include decision models, value of information and control, risk attitude, spreadsheet applications, and decision analysis cycle. Interactive case study.

Typically offered in Fall, Spring, and Summer

MBA 548 Analytical Supply Chain Management (3 credit hours)
The objective of the course is to build an understanding of how to manage and improve the performance (efficiency and responsiveness) of operations and supply chains through decision making that is based on analysis and facts, rather than intuition. The course introduces fundamental aspects of operations and supply chain management as well as analytical modeling tools and techniques that can be used to support decision making (e.g., optimization, regression analysis, simulation). The approach taken in the course is entirely example-based and hands-on, since all these techniques will be implemented in Excel, either with Excel's built-in tools or with Excel add-ins.

Prerequisites: MBA 507 and MBA 540
Typically offered in Fall only

MBA 549 Supply Chain Management Practicum (3 credit hours)
Research project examining supply chain management issues at an organization, usually a member of the Supply Chain Resource Cooperative. Projects will typically focus on procurement, logistics, materials management, operations, or integrated supply chain issues.

Prerequisite: MBA 540
Typically offered in Fall and Spring

MBA 551 Predictive Analytics for Business and Big Data (3 credit hours)
This course is designed around the full analytics lifecycle which encompasses the business problem, the data, the analysis, and the decision. Students will learn to identify and clearly explain business problems that can be addressed with analytics. They will learn to determine which analytic methods are best suited to solve particular problems and clearly explain the results of an analytic model and how those results might impact the business bottom line. Analytical methods to be covered include data, visualization, a review of regression analysis; logistic regression; classification and regression trees (including boosting and bagging methodologies); and clustering (segmentation) methods. Students will also develop at least a beginning proficiency with several statistical software packages including Tableau, JMP, R, and SAS Enterprise Miner. Emphasis will be placed on analyzing real data and understanding how analytical thinking can be applied to solve big data problems.

Prerequisites: MBA 506 and MBA 507
Typically offered in Fall, Spring, and Summer

MBA 552 Data Engineering, Management and Warehousing (3 credit hours)
This course examines how to collect and process data to make it useful, how to validate, protect, and process data to make it available, and how to create a place to properly store data.

Typically offered in Fall, Spring, and Summer

MBA 555 Product Design and Development (4 credit hours)
Total product realization process, including customer needs analysis, product design and engineering, manufacturability assessment and marketing plan development. Definition of relevant market, design and engineering principles, financial considerations and manufacturing aspects of product development process. Application and integration of business, design and engineering methodologies, concepts and tools on actual product design and development project.

Typically offered in Fall only

MBA 558 Artificial Intelligence in Management (1 credit hours)
This course will discuss artificial intelligence (AI) and its applications to help make data-driven decisions in business and management. Students will learn to understand the language of AI, discuss different applications of AI, and work with actual AI tools at a high level to develop new insights. Hands-on examples will be complemented by applications of AI drawn from different industries.

Typically offered in Spring only

MBA 559 Business Analytics Practicum (3 credit hours)
This course focuses on solving a real-world business problem that includes a heavy data analytic component. The business problem will vary according to the client but could include problems from finance, human resources, marketing, finance, supply chain, or other management areas.

Prerequisite: MBA 506 and MBA 507 and MBA 551
Typically offered in Fall and Spring

MBA 560 Marketing Management and Strategy (2 credit hours)
Market segmentation, targeting, and positioning. Channels of distribution, promotion strategy, product development strategy, and pricing strategy. Relationship marketing and marketing strategy. Applications in high-tech environments. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 561 Consumer Behavior (3 credit hours)
Consumer perception of products and brands, including the role of product design and development of consumer attitudes. Analysis of how consumers make decisions and how those decisions can be influenced by messaging, pricing, and emotions.

Typically offered in Fall and Spring

MBA 562 Research Methods In Marketing (3 credit hours)
A systematic approach to structure, implementation and analysis of marketing research for decision making. Models of consumer demand and firm behavior analyzed in a marketing context.

Typically offered in Fall only

MBA 563 Product and Brand Management (3 credit hours)
Marketing planning and product management. New product concept evaluation and selection. Managing products over the life cycle. Developing and implementing a brand strategy. Repositioning and revitalizing brands Brand extension. Managing globalbrands.

Typically offered in Fall and Spring

MBA 564 Business Relationship Management (3 credit hours)
Strategic, successful management of the multitude of business relationships that contemporary managers face. Universal and idiosyncratic business relationship skills to allow technically-oriented managers such as engineers and scientists to interact with a variety of constituents. Integrated perspective of marketing communications as a process of successfully interacting with each constituency with the goal of fostering long-term satisfaction and loyalty, which ultimately translates to sustainable competitive advantage.

Typically offered in Fall and Spring

MBA 565 Marketing Analytics (3 credit hours)
Analytical techniques to convert a wealth of data on customers and markets into insights to guide business decisions. Taking a hands-on and systematic approach on the steps involved in harnessing knowledge from data, the course covers the various data techniques and steps involved in data- and model-driven management decisions. Techniques include market response models, conjoint analysis, discrete choice models.

Prerequisites: MBA 507 and MBA 560
Typically offered in Fall and Spring

MBA 566 Digital Marketing (3 credit hours)
This course covers the basics of digital marketing from an analytics perspective. Each channel of digital marketing, such as search engine optimization, social, mobile, web, email, and video, are examined and their relationship to overall firm marketing strategy is explored.

Typically offered in Spring only

MBA 570 Opportunity Evaluation and Value Creation (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Management of the innovative activities of a firm (new and/or existing) to facilitate entrepreneurship-the discovery, evaluation, and exploitation of opportunities to create value. Generation and screening of new product/process ideas or concepts. Transformation of such ideas into products, processes, or services that satisfies stakeholders (e.g., customers, employees). Topics include self-assessment of personal aspirations, skills, and competencies, as well as opportunity identification/evaluation, business model design, and launching and scaling ventures.

Credit not allowed in MBA 570 if the student has already taken MBA 576 or MBA 577.
Typically offered in Fall only

MBA 571 High Growth Entrepreneurship (3 credit hours)
Second course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Theoretical and practical, team-based, approach to the evaluation and assessment of opportunities for value creation. Emphasis on how to discover, validate, and then execute on an action plan to create value. Credit not allowed if the student has already taken MBA 576 or MBA 577.

Prerequisite: MBA 570. Credit not allowed if the student has already taken MBA 576 or MBA 577.
Typically offered in Spring only

MBA 572 Venture Opportunity Analytics (3 credit hours)
Application of the process-based model for new business startups to multiple clients. Emphasis is placed on data gathering, data analysis and data interpretation in the context of evaluating opportunities for new business. Students work in teams on a variety of projects with technology commercialization clients such as Wolfpack Investment Network and Office of Technology Commercialization and New Ventures.

Typically offered in Fall and Spring

MBA 576/MSE 576 Technology Entrepreneurship and Commercialization I (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities for technology commercialization. Evaluation of commercialization of technologies in the context of new business startups. Emphasis is placed on creating value through technology portfolio evaluation and fundamentals of technology-based new business startups. This includes development of value propositions and strong technology-product-market linkages. The process based approach is appropriate for new business startup as well as entrepreneurship in existing organizations through spinoffs, licensing, or new product development. Credit not allowed for MBA 576 if the student has already taken MBA 570 or MBA 571.

Credit not allowed in MBA 576 if the student has already taken MBA 570 or MBA 571
Typically offered in Fall and Spring

MBA 577/MSE 577 Technology Entrepreneurship and Commercialization II (3 credit hours)
Continuation of evaluation of technologies for commercialization through new business startups. Emphasis is placed on creating value through strong technology-products-markets linkages using the TEC algorithm. Topics include industry and market testing of assumptions, legal forms of new business startups, funding sources and creating a quality, integrative new business startup plan. Credit not allowed in 577 for students who have already taken 570 or 571.

Prerequisite: MBA/MSE 576. Credit not allowed in 577 for students who have already taken 570 or 571.
Typically offered in Fall and Spring

MBA 578 Venture Launch (3 credit hours)
Immersion in the activities of opportunity exploitation. Students work in groups to plan and execute the launch of a new value creating entity. Strategy formulation and strategy implementation for a new business startup. Includes all aspects of value creation for success as a new venture.

Prerequisite: MBA 571 or MBA 577
Typically offered in Fall and Spring

MBA 579 Entrepreneurship Clinic Practicum (3 credit hours)
Inspired by the university teaching hospital model, the NC State Entrepreneurship Clinic is a place where students, faculty, entrepreneurs, and service providers go to teach, learn and build the next generation of businesses in Raleigh. Each person in this class will take on the role of "Clinic Lead" managing groups of undergraduate students working with clients of the NC State Entrepreneurship Clinic during the semester developing ideas, evaluating options, and providing insights to emerging ventures.

Typically offered in Fall and Spring

MBA 580 Creating Value in Organizations (3 credit hours)
Process-based approach to creating high value in existing organizations by understanding strategy formulation and implementation. The approach also will reapplied to entrepreneurs in new venture startups as well as organizations managing innovation and technology changes. Emphasis is placed on learning by applying these processes to existing organizations through strategic management and to new business startups through entrepreneurship. Restricted to MBA students.

Typically offered in Fall, Spring, and Summer

MBA 582 Sustainability and Business (3 credit hours)
Explore the current sustainability trends. Learn how business are integrating sustainability into their strategies. Gain an understanding of the tools businesses are using to operate businesses in a sustainability manner. Experience current and evolving sustainability reporting practices. Explore future trends.

Typically offered in Fall only

MBA 585 Current Topics in BioSciences Management (3 credit hours)
Business processes and strategies across the global BioSciences value chain, including the R&D realities, product life cycles, key elements of product discovery and development, intellectual property, regulatory trials, government approval, production, sourcing, logistics, sales, marketing and customer service. The complete value chain of a new biotechnology-based product.

Typically offered in Spring only

MBA 586 Legal, Regulatory and Ethical Issues in Life Science Industries (3 credit hours)
Exploration of unique environment in which biotechnology research is conducted and resultant drugs and products are sold. Legal restraints affecting pharmaceutical marketing and reimbursement options; regulatory issues; pre-clinical research. Laws limiting or affecting pharmaceutical and biomedical marketing Ethical issues in the research and marketing processes.

Typically offered in Fall only

MBA 589 Jenkins Consulting Practicum (3 credit hours)
This class provides the opportunity to learn about business consulting and be part of a consulting team, helping real clients with real business challenges and market opportunities. Students will help their client organization by understanding a problem, conducting analyses, and suggesting relevant, actionable steps that clients can take to become more competitive or achieve important goals. Projects will deal with creative, complex, risky, and ambiguous issues involved in developing new products/services, serving new markets, achieving quality standards, or creating new business models in an enterprise setting.

Restriction: MBA Students Only
Typically offered in Fall, Spring, and Summer

MBA 590 Special Topics In Business Management (1-6 credit hours)
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

MBA 610 Special Topics in Business Administration (1-6 credit hours)
Special topics course dealing with issues not covered in regularly scheduled courses. Restricted to MBA students.

MBA 630 Independent Study In Business Management (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall, Spring, and Summer

Business Management (BUS)

BUS 225 Personal Finance (3 credit hours)
Economic and financial strategies used to accumulate, manage and protect personal assets. Emphasizing income generation, expense reduction, investment selection, and wealth creation to meet future needs and goals. Topics include investing (mutual funds, stocks, etc.), annuities, insurance, retirement planning, and estate planning.

Typically offered in Fall, Spring, and Summer

BUS 295 Special Topics in Business Management (1-6 credit hours)
Experimental course development. Special topics in Business Management at the introductory level.

BUS 320 Financial Management (3 credit hours)
Financial decision making by businesses, including capital structure and dividend decisions, capital budgeting and working capital management. Basic financial concepts are covered such as risk and return measurement, portfolio theory and the time value of money.

Prerequisite: ACC 210
Typically offered in Fall, Spring, and Summer

BUS 340 Information Systems Management (3 credit hours)
Fundamentals of information systems development and use in organizational setting. Information systems (IS), concepts, hardware, software, telecommunications, database management. IS development, applications and management in telecommunications,database management, various business processes, global issues, security and ethical challenges.

Typically offered in Fall, Spring, and Summer

BUS 350/ST 350 Economics and Business Statistics (3 credit hours)
Introduction to statistics applied to management, accounting, and economic problems. Emphasis on statistical estimation, inference, simple and multiple regression, and analysis of variance. Use of computers to apply statistical methods to problems encountered in management and economics.

Prerequisite: MA 114
Typically offered in Fall, Spring, and Summer

BUS 351 Predictive Analytics for Business (3 credit hours)
This course builds on BUS/ST 350 with an emphasis on the application of statistical methods using software. The course uses analytical methods and tools to drive actionable business decisions. Students will be exposed to a variety of statistical and machine learning methods including linear regression, logistic regression, decision analysis, classification trees, clustering techniques, optimization, monte carlo simulation, and statistical forecasting.

Prerequisites: BUS 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372); Corequisite: ST 307 or ST 308
Typically offered in Fall and Spring

BUS 360 Marketing Methods (3 credit hours)
Examination of decisions affecting marketing of goods and services in consumer, industrial and international markets. Emphasis on the role of marketing in a managerial context. Areas studied include: the activities of marketing research, identification of marketing opportunities, and the development of marketing mix strategies including the decisions concerning pricing, distribution, promotion and product design.

Prerequisite: MIE 201, Sophomore standing
Typically offered in Fall, Spring, and Summer

BUS 370 Operations and Supply Chain Management (3 credit hours)
Concepts in planning, controlling, and managing the operations function of manufacturing and service firms. Topics include operations strategy, process choice decisions, forecasting, production planning and control, and trends in operations management. Common tools for informed decision-making in these areas.

Typically offered in Fall, Spring, and Summer

BUS 420 Financial Management of Corporations (3 credit hours)
Advanced theory and practice of corporate financial management. Topics covered include: asset management, evaluating financial statements, capital budgeting, alternative investments, cash flow management, equity valuation, and financing. Corporate financial policy decisions will include: cost of capital, capital structure, and dividend policy decisions.

Prerequisite: BUS 320 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall, Spring, and Summer

BUS 422 Investments and Portfolio Management (3 credit hours)
Analysis of the investment process, dichotomized into security analysis and portfolio management. Background information on financial assets, securities markets, and risk-return concepts. Analysis of valuation theory and techniques, modern portfoliotheory and portfolio performance.

Prerequisite: BUS 320 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall and Spring

BUS 425 Advanced Personal Financial Management (3 credit hours)
Detailed economic, financial and legal analysis of risk management, retirement planning, investments, and estate planning. Additional emphasis on professional financial planning for those interested in personal finance as a career.

Prerequisite: BUS 320
Typically offered in Fall and Spring

BUS 426 International Financial Management (3 credit hours)
Foreign exchange markets, forward markets and derivatives, and their implications for direct and portfolio investment abroad. International capital markets. Multinational company exchange rate exposure measurement and management. Instruments of financing international trade and investment. Multinational capital budgeting and cost of capital.

Prerequisite: BUS 320 and (BUS/ST 350 or ST 305 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

BUS 428 Financial Analytics (3 credit hours)
Advanced course examining the use of big data analytics in finance. The focus will be on the application of these tools in the areas of asset management and equity valuation. Topics covered include risk-return tradeoff, financial intermediaries in asset management (e.g., mutual funds, hedge funds, etc.), stock valuation models, and using financial statement information in stock selection / asset management. Students will complete a semester-long project involving data analysis (e.g., write an equity research report on a publicly traded U.S. firm, backtest an investment strategy, etc.).

Prerequisite: BUS 320
Typically offered in Spring only

BUS 429 Financial Modeling (3 credit hours)
BUS 429 is 'corporate finance in Excel.' Starting from the theoretical base gained in BUS320, students work through problems in time value of money, capital budgeting, and valuation (among other things) using spreadsheet analyses. The course will take a very hands-on approach in building financial spreadsheet models. Microsoft Excel is the primary tool we will use to implement these financial models and the course will go into detail on the proficient use of Excel.

Prerequisite: BUS 320
Typically offered in Fall and Spring

BUS 440 Database Management (3 credit hours)
The fundamentals of database management within business applications. Data structures, user requirements, structured query language, query by example, application development, user interface design.

Prerequisite: ACC 340 or BUS 340
Typically offered in Fall and Spring

BUS 441 Business Data Communications and Networking (3 credit hours)
The fundamentals of computer networking and the use of computer networks in business applications. Client-server networks, architecture, network hardware and software, key issues in network management, network security, and the fundamentals of datacommunications.

Prerequisite: ACC 340 or BUS 340
Typically offered in Fall and Spring

BUS 442 Information Systems Development (3 credit hours)
This course provides concepts and skills necessary for designing, developing, and deploying information systems (applications) to aid in business and managerial decisions. It includes hands-on experience with development (coding) theory and concepts, objected-oriented algorithm design and development concepts, graphical user interface design concepts, and SQL and data structures using the C# programming language and the Microsoft. NET IDE.

Prerequisite: ACC 340 or BUS 340
Typically offered in Fall and Spring

BUS 443 Web Development for Business Applications (3 credit hours)
This course provides current technologies for designing and developing interactive, web-based systems for business. Topics may include current programming languages, server-side programming, client-side programming, server-side scripting, database integration, and more. Design concepts will be implemented through team projects.

Prerequisite: BUS 442; Corequisite: BUS 440
Typically offered in Fall and Spring

BUS 444 Systems Analysis and Design (3 credit hours)
This course provides an overview of methods for developing Information Systems. Principles and techniques of systems analysis and design are introduced so that students can successfully cope with the complexities of developing information systems. Topics include software development frameworks, project management, requirements analysis, systems analysis techniques, and systems design. Systems analysis and design methods covered include agile software engineering, structured analysis and design, and object-oriented analysis and design techniques.

Prerequisite: ACC 340 or BUS 340
Typically offered in Fall and Spring

BUS 449 Information Technology Capstone (3 credit hours)
This is a completely project-oriented course. Students will work on real applications for national or local firm(s) to solve "live" IT problems. Students will work in teams to develop client deliverables and present their final work to an appropriate industry-based management team. Field trips and/or outside class activities (including client/consultant work) are a major part of this course. Students who are unable to participate in these types of events should not enroll in this course.

Prerequisite: BUS 440 or 441 or 442 or 443 or 444.
Typically offered in Spring only

BUS 458/ACC 458 Analytics: From Data to Decisions (3 credit hours)
Students will develop and apply their data analytics skills by analyzing case studies built around real business problems and real data. Case studies are designed around the full analytics lifecycle which encompasses the business problem, data, analysis, and decision. Students will learn to identify and explain business problems that can be addressed with analytics. They also will learn to determine which analytic methods are best suited to solve particular problems and will evaluate the impact of applying analytic methods. Finally, they will learn to explain the results of an analytic model and how those results impact the business "bottom line.

Prerequisite: BUS 351
Typically offered in Fall and Spring

BUS 459 Business Analytics Practicum (3 credit hours)
Advanced application of business analytics skills, tools and methodologies to solve business issues and problems. Small teams of students will undertake projects to identify business issues, confirm the information needed to address the issues, and apply the required data analytics tools and methodologies. The projects will include interaction with business personnel, refinement of business issues, gathering information, development of business analytics models, and presentation of results through data visualization. Each project will culminate with the student team presenting their findings and recommendations to the organization.

Prerequisites: BUS 351 and BUS 458
Typically offered in Fall and Spring

BUS 460 Consumer Behavior (3 credit hours)
The consumer decision process, with emphasis on consumer decision making, satisfaction/dissatisfaction factors, perception, learning, group influences, and marketing strategy implications. Restricted to majors within the College of Management.

Prerequisite: BUS 360
Typically offered in Spring only

BUS 461 Channel and Retail Marketing (3 credit hours)
Retailing composes a substantial component of the US economy, creating millions of jobs. Marketing channels are where marketing mix strategy and tactics ultimately impact customers and produce sales. This course is designed to prepare students for roles such as buying, merchandising, store management, professional selling, distribution, inventory management or other retailing-oriented careers. Emphasis will be placed on developing students relevant skill sets in key areas such as retail metrics, site analysis, pricing tactics, merchandising strategy, and customer relationship management. Relevant aspects of consumer behavior and organizational leadership in a retail setting will be covered.

Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 462 Marketing Research (3 credit hours)
The use, collection, organization and analysis of information pertinent to marketing decisions. Use of qualitative and quantitative data in the solution of specific marketing problems.

Prerequisite: BUS 360 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall, Spring, and Summer

BUS 463 Sales and Marketing Practicum (3 credit hours)
This course is a team-based project course where students work on a sales/marketing problem for a business enterprise. Students, company team leads (clients), and the NCSU faculty advisor will work together to document the project scope early in the semester. Ultimately, the student team will be responsible for project management. Components of this typically include a project scope, project work plan, key deliverables and milestones. The projects usually consist of building a framework for analyzing the project data, development of reasonable recommendations for action in both the long and short term, and various reports and presentations to project stakeholders: company participants and management, and the NCSU faculty advisor.

P: BUS 360 and one other Marketing Concentration Course (BUS 460, 461, 462, 465, 466, 467, 468, or 469)
Typically offered in Fall and Spring

BUS 464 International Marketing (3 credit hours)
Explores moving from a national marketing approach to a global marketing strategy, and discusses competitive advantages and challenges in making the transition. Both traditional countries of Western Europe and emerging markets will be examined. Students will analyze culture considerations when evaluating the impact on local business strategies. In addition to learning the impact on the world's economy through globalization, emphasis will also be placed on developing necessary professional skills.

Prerequisite: BUS 360
Typically offered in Spring only

BUS 465 Traditional and Digital Brand Promotion (3 credit hours)
This course focuses on advertising and integrated brand promotions, spanning both traditional and digital media. Emphasis is on the brand. Includes development of marketing communications strategy and campaign materials, from consumer insight generation to creative execution.

Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 466 Personal Selling (3 credit hours)
Revolves around the art of people-to-people interaction, which applies not only to the business-to-business sales environment but is also applicable to other professions. The selling process will be examined along with activities necessary to be successful in sales. With a common thread of developing and nurturing relationships, students will examine building partnerships, implications of ethical and legal issues, adapting the approach to the situation and identifying social styles with associated behaviors. Attention will also be focused on the steps involved in the sales cycle and how to be successful in their execution.

Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 467 Product and Brand Management (3 credit hours)
Provides an in-depth understanding of marketing planning and implementation involved in product and brand management. The course places emphasis on developing specific marketing strategies to support the creation and launch of new products and to successfully manage existing products and brands.

Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 468 Marketing Strategy (3 credit hours)
This course is designed to build on the core marketing principles you learned in your introductory marketing course and to enhance your understanding of their strategic implications.

Prerequisite: BUS 360
Typically offered in Spring only

BUS 469 Digital Marketing Practicum (3 credit hours)
This course provides you with an introduction to the digital marketplace through an experiential learning approach. After conducting a client audit, your team will develop a digital marketing campaign including appropriate major digital platforms. Post-campaign metrics and data analytics will be utilized to measure campaign effectiveness and future marketing strategy. The course pedagogy emphasizes class discussion, industry expert lectures, digital simulation, and a client digital project.

Prerequisite: BUS 360
Typically offered in Fall and Spring

BUS 470 Operations Modeling and Analysis (3 credit hours)
Tools, techniques, and strategies used for analyzing and improving business operations, including process mapping, capacity analysis, demand forecasting, and quality analysis and improvement. Emphasis on Excel as a tool for analysis, particularly on Excel functions and modules relevant to operations analysis.

Prerequisite: BUS 370 and (BUS/ST 350 or ST 305 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

BUS 472 Operations Planning and Control Systems (3 credit hours)
Design and management of operations planning and control systems for manufacturing and service firms. Forecasting, capacity management, production and work force scheduling, project management, just-in-time and time-based competition, the impact ofinformation technologies on planning and control systems.

Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 473 Supply Chain Strategy (3 credit hours)
THERE ARE NO PLANS TO OFFER THIS COURSE IN THE FORESEEABLE FUTURE. Purchasing, materials management, and logistics. Purchasing systems, supplier-based strategies, price-cost management, value analysis. Inventory strategies, quantity and quality decisions, materials planning. Logistics strategies for services and manufacturing.

Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Spring only

BUS 474 Logistics Management (3 credit hours)
Management of physical flows of goods between firms, management of inventories that support those flows, and assessment of the effects of freight transportation choices on these management activities. A variety of conceptual frameworks and quantitative tools are used to formulate the basis for effective logistics decision making and relate those decisions to broader issues in managing the entire supply chain and fulfilling the strategic objectives of a firm. A nominal fee for simulation software may be required.

Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 475 Purchasing and Supply Management (3 credit hours)
This course is designed to help students develop knowledge of basic principles in purchasing and supply management. Students will be able to explain the potential contributions of these efforts of the competitiveness of the firm.

Prerequisite: BUS 370; Co-requisite: BUS 470
Typically offered in Fall and Spring

BUS 476 Decision Modeling and Analysis (3 credit hours)
Structured framework and process for modeling and analyzing business decisions. Business decisions are frequently made difficult by the presence of uncertainty and complex interactions among key drivers of the decision. In today's global environment the stakes of bad outcomes may be too high to justify learning by experience. Filled with in-depth insights and practical advice, this course covers the essential tools and techniques to improve your skills, such as: decision trees, influence diagrams, spreadsheet-based decision modeling, Monte Carlo simulation, demand forecasting, and methods to obtain and model decision-relevant data from subject matter experts in an unbiased manner.

Prerequisite: BUS 340 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Fall and Spring

BUS 479 Supply Chain Management Undergraduate Practicum (3 credit hours)
This course is comprised of a team-based project working on a Supply Chain Resource Consortium (SCRC) partner company's supply chain management issues. These projects vary in scope as are company's supply chain issues and improvement initiatives.Student groups need to provide their own transportation to off-campus sites.

Prerequisite: BUS 370 and one 400-level Operations/Supply Chain Management course
Typically offered in Fall and Spring

BUS 495 Special Topics in Business Management (1-6 credit hours)
Presentation of material not normally available in regular course offerings, or offering of new courses on a trial basis.

BUS 498 Independent Study in Business Management (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Department Head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

BUS 501 Strategic Management Foundations (3 credit hours)
This course is designed to help students with an engineering or scientific undergraduate degree understand the world of business. The class will cover key business functions including finance, marketing, operations, strategy, organizational behavior. Students will undertake a semester-long group project to design and plan for a new company or new product within an existing company. Restricted to students with an engineering, scientific, or other technical background.

Typically offered in Fall and Spring

BUS 541 Strategic Risk Analysis Using Excel (1 credit hours)
This course explores the use of data analysis techniques and tools that are useful for organizing and categorizing large volumes of information for use by executives to make strategic business decisions. The course exposes students to various Excel techniques through a business case to support management's decision making and focuses on how data analysis can be used to inform management and the board about top strategic risk issues.

Typically offered in Fall and Spring

BUS 542 Forecasting and Scenario Planning Using Monte Carlo Simulation (1 credit hours)
This course explores how forecasting and scenario planning are used to support management's decision making. The course focuses on how data analysis techniques and tools are useful for organizing and categorizing large volumes of information for use by executives to make strategic business decisions and it exposes students to Monte Carlo Simulation and Optimization techniques to support strategic business decisions. The course then focuses on communicating this information to inform management and the board about top strategic risk issues.

Typically offered in Fall and Spring

BUS 543 Communicating Risk Information Using Tableau (3 credit hours)
This course provides an introduction as well as hands-on experience in data visualization. It introduces students to design principles for creating meaningful displays of quantitative and qualitative data to facilitate managerial decision-making. Students develop an understanding of the fundamentals of communication and alignment around concepts that are required for effective data presentation and it provides an overview and develop an introductory level of competency on the use of the Tableau software tool that can be used for data visualization.

Typically offered in Fall and Spring

BUS 554 Project Management (3 credit hours)
Life cycle view of organizing and managing technical projects, including project selection, planning, and execution. Methods for managing and controlling project costs, schedules, and scope. Techniques for assessing project risk. Use of popular project management software tools. Application of project management tools and methods to product development, software, and process reengineering projects.

Typically offered in Spring and Summer

BUS 558 Communications, Privacy, and Ethics in Data Science (2 credit hours)
This class will give you the opportunity to explore the ethical issues associated with the development and use of Big Data and data science activities. The data science lifecycle will serve as a backdrop within which to examine ethical concerns related to the design, collection, use and dissemination of data. These include issues of AI and bias, transparency in communications and data design, privacy and data collection, among others.

Typically offered in Spring only

BUS 571 High Growth Entrepreneurship (3 credit hours)
Second course in a two-course entrepreneurship sequence focusing on opportunities outside the technology arena. Theoretical and practical, team-based, approach to the evaluation and assessment of opportunities for value creation. Emphasis on how to discover, validate, and then execute on an action plan to create value. Credit not allowed if the student has already taken MBA 576 or MBA 577.

Prerequisite: MBA 570. Credit not allowed if the student has already taken MBA 576 or MBA 577.
Typically offered in Fall and Spring

BUS 590 Special Topics In Business Management (1-6 credit hours)
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

BUS 790 Special Topics In Business Management (1-6 credit hours)
Presentation of material not normally available in regular courses offerings or offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

Chemical Engineering (CHE)

CHE 205 Chemical Process Principles (4 credit hours)
Engineering methods of treating material balances, stoichiometry, phase equilibrium calculations, thermophysics, thermochemistry and the first law of thermodynamics. Introduction to equation solving packages and spreadsheets for solving problems related to chemical engineering calculations.

Prerequisite: Grade of C or better in MA 241, PY 205, and (CH 201 or CH 221 or CH 225)
Typically offered in Fall, Spring, and Summer

CHE 225 Introduction to Chemical Engineering Analysis (3 credit hours)
Introduction of mathematical and computational tools for analyzing chemical engineering problems. Sequential modular and equation-based simulation of steady-state chemical processes using advanced spreadsheet methods and multivariate root-finding algorithms. Material and energy balances on transient processes and their solution using analytical and numerical methods. Introduction to microscopic material and energy balances using the "shell balance" approach to develop the governing differential equations. Solutions to steady-state boundary value problems in heat conduction and Fickian diffusion.

Prerequisite: C- or better in CHE 205 and MA 242; Corequisite: MA 341
Typically offered in Fall, Spring, and Summer

CHE 311 Transport Processes I (3 credit hours)
Fundamental aspects of momentum and heat transfer, and the use of these fundamentals in solving problems in transport operations.

Prerequisite: Grade of C- or better in both CHE 225 and MA 341
Typically offered in Fall, Spring, and Summer

CHE 312 Transport Processes II (3 credit hours)
Fundamental aspects of mass transfer and the use of these basic principles in solving problems in transport operations.

Prerequisite: Grade of C- or better in CHE 311
Typically offered in Fall and Spring

CHE 315 Chemical Process Thermodynamics (3 credit hours)
Laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

Prerequisite: Grade of C- or better in CHE 225
Typically offered in Fall and Spring

CHE 316 Thermodynamics of Chemical and Phase Equilibria (3 credit hours)
Systematic study of chemical reaction equilibria and phase equilibria. Use of fugacity, activity and chemical potential concepts for predicting the effect of such variables as temperature, pressure on equilibrium compositions. Methods for measuring and estimating thermodynamic properties important to equilibrium calculation in real systems.

Prerequisite: Grade of C- or better in CHE 315
Typically offered in Fall, Spring, and Summer

CHE 330 Chemical Engineering Lab I (4 credit hours)
Laboratory experiments in unit operations of heat transfer and fluid flow. Laboratory safety, technical report writing, statistics, experimental design, error analysis and instrumentation.

Prerequisite: CHE 311
Typically offered in Fall and Spring

CHE 331 Chemical Engineering Lab II (2 credit hours)
Laboratory experiments in mass transfer and reaction kinetics. Experimental planning, technical report writing and oral presentations are emphasized.

Prerequisite: CHE 312, CHE 330
Typically offered in Fall and Spring

CHE 395 Professional Development Seminar (1 credit hours)
Professional development and topics of current interest in chemical engineering.

Typically offered in Fall and Spring

CHE 435/TE 435 Process Systems Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical and material engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

Prerequisite: (MA 341 and TE 205) or CHE 312
Typically offered in Fall and Spring

CHE 446 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of the rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit cannot be received for both CHE 446 and CHE 546.

Prerequisite: CHE 316
Typically offered in Fall only

CHE 447 Bioreactor Engineering (3 credit hours)
Design and analysis of chemical reactors with emphasis on enzyme-catalyzed reactions, microbial fermentation, and animal cell culture. Empirical kinetics of enzymatic reactions and cell growth. Design and scale-up of suspension bioreactors. Immobilized-enzyme and immobilized-cell bioreactors, including the classical Thiele reaction-diffusion analysis.

Prerequisite: CHE 312 and CHE 316; Corequisite: BCH 451
Typically offered in Fall only

CHE 448/BEC 448/BEC 548/CHE 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

CHE 450 Chemical Engineering Design I (3 credit hours)
Applications of cost accounting, cost estimation for new equipment, manufacturing cost and measures of profitability. Use of computer simulation design and cost programs. Procedures for sizing unit operations commonly encountered in the chemical process industry. Heuristics for selection of separation processes and heat exchanger network synthesis.

Prerequisite: CHE 312; Corequisite: CHE 446 or CHE 447
Typically offered in Fall only

CHE 451 Chemical Engineering Design II (3 credit hours)
Chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project design, and production management. Comprehensive design problems.

Prerequisite: CHE 450, and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 452/CHE 552 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and 'omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.

Corequisites: CHE 448 and BCH 451
Typically offered in Spring only

CHE 460/CHE 560 Chemical Processing of Electronic Materials (3 credit hours)
This course is an introduction to electronic materials, chemical processes used in their fabrication, and basic physical principles of electronic device operation and function. The course will address how principles of chemical engineering are applied to design and fabricate current and emerging electronic systems. We will also discuss emerging areas of electronic technologies, including organic semiconductors, advanced energy conversion, and quantum computing and related systems. Credit for both CHE 460 and CHE 560 is not allowed.

Prerequisite: CHE 446 or permission of instructor
Typically offered in Spring only

CHE 461 Polymer Sciences and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

Prerequisite: (CH 223 or CH 227) and CHE 316
Typically offered in Fall only

CHE 462/CHE 562/BEC 462/BEC 562 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 463/BEC 463/BIT 563/CHE 563/BEC 563/BIT 463 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

CHE 465 Colloidal and Nanoscale Engineering (3 credit hours)
The first part of this course will present the fundamentals of nanoscale colloidal processes, including interactions and self-assembly of particles, surfactants and biomolecules. The applications of these fundamentals to the nanotechnology and engineering on the nanoscale will be discussed. The nanoscience has led to the development of many new technologies with relevance to chemical engineering, including microfluidics, lab-on-a-chip, bioarrays and bioassays. These emerging technologies will be presented and discussed in the second half of this course.

Prerequisite: C- or better in CHE 311 and CHE 315.
Typically offered in Fall and Spring

CHE 467 Polymer Rheology (3 credit hours)
Theoretical principles and experimental techniques associated with flow and deformation of polymer systems. Systems include: meffs and solutions, suspension, gels, emulsions, and thixotropic materials.

Prerequisite: CHE 311
Typically offered in Spring only

CHE 468/CHE 568/ECE 568/ECE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

CHE 475/CHE 575 Advances in Pollution Prevention: Environmental Management for the Future (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of more efficient processes.

Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 488/BEC 588/CHE 588/BEC 488 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

CHE 495 Honors Thesis Preparation (1 credit hours)
Development and presentation of Honors Thesis in Chemical Engineering and discussion of graduate school selection and preparation.

Prerequisite: CHE 497, Senior standing
Typically offered in Spring only

CHE 497 Chemical Engineering Projects I (3 credit hours)
Introduction to chemical engineering research through experimental, theoretical and literature studies. Oral and written presentation of reports.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 498 Chemical Engineering Projects II (1-3 credit hours)
Projects in research, design or development in various areas of chemical engineering.

Prerequisite: Junior standing
Typically offered in Fall, Spring, and Summer

CHE 525 Process System Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques. Credit for both CHE 425 and CHE 525 is not allowed.

Prerequisite: CHE 312
Typically offered in Spring only

CHE 543 Polymer Science and Technology (3 credit hours)
Concepts and techniques for polymerization of macromolecules. Structure, properties, and applications of commercially important polymers.

Prerequisite: CHE 223, CHE 316
Typically offered in Fall and Summer

CHE 546 Design and Analysis of Chemical Reactors (3 credit hours)
Characterization and measurement of rates of homogeneous and heterogeneous reactions. Design and analysis of chemical reactors. Credit for both CHE 446 and CHE 546 is not allowed.

Prerequisite: CHE 316
Typically offered in Fall only

CHE 548/CHE 448/BEC 448/BEC 548 Bioreactor Design (2 credit hours)
This course will cover critical aspects of bioreactor design, including design of reactors for enzyme-catalyzed reactions, fermentation of microorganisms, and scale-up considerations for bioreactors. Hands-on experiments involving fermentation of microorganisms and scale-up of bioreactors will be included. Students cannot get credit for both CHE 448 and CHE 548.

Prerequisite CHE 446 or instructor permission; Co-requisite BCH 451 or instructor permission
Typically offered in Spring only

CHE 551 Biochemical Engineering (3 credit hours)
Enzyme and microbial kinetics and reactor designs for processes involving enzymes and single and mixed cultures. Samples drawn from full range of applications: food processing, single cell proteins, tissue culture and vaccines, monoclonal antibodies, recombinant DNA and hybridomas, artificial organs, biological waste treatment and environmental processes.

Prerequisite: CHE 312 and (CHE 446 or CHE 447)
Typically offered in Spring only

CHE 552/CHE 452 Biomolecular Engineering (2 credit hours)
This course will cover modern methods in biomolecule design, including gene expression regulators, RNA structure, protein structure, and metabolic networks. Current methods in genetic engineering and 'omics-based analysis will be discussed, followed by a critical review of current literature on the applications of these methods to engineering microbes, cells, and multi-species communities. Hands-on assignments involving computational design will be included.

Corequisites: CHE 448 and BCH 451
Typically offered in Spring only

CHE 560/CHE 460 Chemical Processing of Electronic Materials (3 credit hours)
This course is an introduction to electronic materials, chemical processes used in their fabrication, and basic physical principles of electronic device operation and function. The course will address how principles of chemical engineering are applied to design and fabricate current and emerging electronic systems. We will also discuss emerging areas of electronic technologies, including organic semiconductors, advanced energy conversion, and quantum computing and related systems. Credit for both CHE 460 and CHE 560 is not allowed.

Prerequisite: CHE 446 or permission of instructor
Typically offered in Spring only

CHE 562/BEC 462/BEC 562/CHE 462 Fundamentals of Bio-Nanotechnology (3 credit hours)
Concepts of nanotechnology are applied in the synthesis, characterization, recognition and application of biomaterials on the nanoscale. Emphasis will be given to hands-on experience with nanostructured biomaterials; students will also be familiarized with the potential impact of these materials on different aspects of society and potential hazards associated with their preparation and application.

Prerequisite: MA 241 and PY 208 and (CH 223 or CH 227)
Typically offered in Spring only

CHE 563/BEC 563/BIT 463/CHE 463/BEC 463/BIT 563 Fermentation of Recombinant Microorganisms (2 credit hours)
Introduction to fermentation and protein chemistry. Theory behind laboratory techniques and overview of industrial scale expression systems. Laboratory sessions involve use of microbial expression vectors, fermentation systems, and large-scale purification of recombinant protein. Half semester course, first part.

Prerequisite: CH 223 or CH 227; Corequisite: (BIT 410 or BCH 452 or MB 352 or BEC 363)
Typically offered in Fall and Spring

CHE 568/ECE 568/ECE 468/CHE 468 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

CHE 575/CHE 475 Advances in Pollution Prevention: Environmental Management for the Future (3 credit hours)
Design of industrial processes which minimize or eliminate wastes. Regulations and the corporate organization of current pollution prevention efforts. Current pollution prevention research. Product life cycle analysis and the application to design of more efficient processes.

Prerequisite: PY 208, MA 341
Typically offered in Spring only

CHE 577/BEC 577 Advanced Biomanufacturing and Biocatalysis (3 credit hours)
Overview of biomanufacturing using microorganisms (bacteria, yeast, fungi), eukaryotic cells (hybridomas, insect, plant, CHO) and recombinant enzymes focusing on methods used in industry. Course will emphasize process design for optimization of heterologous protein expression, metabolic/cell line engineering, metabolomics, protein engineering to alter enzymes and antibodies. Pathway engineering strategies include developing microbes to produce new therapeutic compounds or overproduce primary metabolites, antibiotics, biotherapeutics, therapeutic enzymes, diagnostics, recombinant vaccines, and biopharmaceuticals. Utilization of immobilized biocatalysts, and microbial kinetics are covered.

Graduate standing in engineering or life-science graduate program
Typically offered in Spring only

CHE 588/BEC 488/CHE 488/BEC 588 Animal Cell Culture Engineering (2 credit hours)
Design and operation of animal cell culture bioreactors for therapeutic protein production. Topics include: batch, fed-batch and perfusion bioreactors, agitation and aeration for mixing and oxygen mass transfer, bioreactor monitoring and control, optimizing bioreactor performance, single-use [disposal] bioreactors, and the production of gene therapy vectors. This is a half-semester course. Time outside of the regularly scheduled class time may be required.

Prerequisite: BEC 463 or CHE 563 or BEC 363 or BEC 440/540 or BEC 441/541 or equivalent; or consent of instructor.
Typically offered in Spring only

CHE 596 Special Topics in Chemical Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CHE 597 Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CHE 601 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

CHE 610 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

CHE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

CHE 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall only

CHE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CHE 697 Advanced Chemical Engineering Projects (1-12 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing in CHE
Typically offered in Fall, Spring, and Summer

CHE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CHE 701 Introduction to Chemical Engineering Research (2 credit hours)
Introduction to graduate research guidelines and practices. Topics include research ethics, electronic literature searching, research proposal structure, technical writing styles, research problem identification, advisor expectations, intellectual property and patents, laboratory notebooks, proposal creation and oral presentation. Graduate standing in chemical engineering or permission of instructor.

Typically offered in Fall only

CHE 702 Chemical Engineering Research Proposition (2 credit hours)
Preparation of a professional quality chemical engineering research proposal. Includes selecting a novel research topic, drafting and finalizing the proposal according to NSF formats, and orally presenting and defending the proposal to a faculty advisory committee. Ethics in proposal preparation.

Prerequisite: CHE 701
Typically offered in Spring only

CHE 711 Chemical Engineering Process Modeling (3 credit hours)
Applications of methods of mathematical analysis to formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering.

Prerequisite: (CHE 312, MA 301 or MA 341) or equivalent
Typically offered in Fall only

CHE 713 Thermodynamics I (3 credit hours)
In-depth coverage of chemical engineering thermodynamics principles. Application of non-ideal fluid-phase chemical potentials to problems in phase and chemical reaction equilibria. Relations of molecular structure and intermolecular forces to macroscopic thermodynamic properties.

Prerequisite: CHE 316 or equivalent
Typically offered in Fall only

CHE 715 Transport Phenomena (3 credit hours)
A theoretical unified study of transport of momentum, energy and matter. Introduction to diffusional operations including coupled heat and mass transfer in light of the theory.

Prerequisite: CHE 311 or equivalent
Typically offered in Spring and Summer

CHE 717 Chemical Reaction Engineering (3 credit hours)
Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors.

Prerequisite: CHE 446 or CHE 447 or equivalent
Typically offered in Fall only

CHE 718 Advanced Chemical Reaction Engineering (3 credit hours)
Topics relating to design, analysis and operation of homogeneous and heterogeneous chemical reactors.

Prerequisite: CHE 717

CHE 719 Electrochemical Systems Analysis (3 credit hours)
Electrochemical thermodynamics, electrochemical kinetics and catalysis, coupled charge and material transport in an electric field and electrophoretic effects. Design and analysis of electrochemical reactors. Survey of electrochemical industry.

Prerequisite: CHE 715, 717
Typically offered in Spring only

CHE 752 Separation Processes For Biological Materials (3 credit hours)
Definition and engineering analysis of major bioseparation techniques useful in product isolation and purification. Solid-liquid separation, crystallization, filtration, extraction, chromatography, membrane processes, distillation, drying, combined operations and process economics.

Prerequisite: CHE 721 or CHE 551

CHE 761/MSE 761 Polymer Blends and Alloys (3 credit hours)
Thermodynamics, morphological characteristics and properties of multiphase polymer systems composed of homopolymers or copolymers. Interfacial characteristics and modification of multicomponent polymer blends through emulsification and reactive blending. Microphase ordering in block copolymers, and emerging technolgies employing these nanostructured materials. Conformational properties and dynamics of macromolecules constrained near an interface.

Prerequisite: CHE 316 or MAT 301
Typically offered in Fall only

CHE 775 Multi-Scale Modeling of Matter (3 credit hours)
Current methods for modeling liquids, soft matter (polymers, surfactant solutions, colloids, liquid crystals, etc), nano-structured materials (nanoparticles, nano-composites, nano-porous materials, etc.), biomolecular systems, and reacting systems at the electronic, atomistic, meso-scale and continuum levels. Graduate level thermodynamics and differential and integral calculus required.

Prerequisite: Graduate level thermodynamics, and differential and integral calculus
Typically offered in Spring only

CHE 796 Special Topics In Chemical Engineering (1-6 credit hours)
Directed reading of chemical engineering literature, introduction to research methodology, and lectures and seminar discussion on topics which vary from term to term.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CHE 797 Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing
Typically offered in Fall only

CHE 798 Advanced Chemical Engineering Projects (1-3 credit hours)
Independent study of some phase of chemical engineering or related field.

Prerequisite: Graduate standing in CHE
Typically offered in Fall, Spring, and Summer

CHE 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

CHE 810 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

CHE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

CHE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CHE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CHE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CHE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CHE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Chemistry (CH)

CH 100 Chemistry and Society (4 credit hours)
Awareness and understanding of chemistry in everyday life for the non-science student. Non-mathematical treatment of essential fundamental concepts. Emphasis on practical applications of chemistry to consumer affairs, energy, medicine, food, sports, and pollution. Laboratory activities are designed to provide a personal experience with the concepts discussed in the course. Credit is not allowed for CH 100 if student has prior credit for CH 101.

R: Credit is not allowed for CH 100 if student has prior credit for CH 101.
GEP Natural Sciences
Typically offered in Fall and Spring

CH 101 Chemistry - A Molecular Science (3 credit hours)
A fundamental study of molecular bonding, structure, and reactivity. Principles of atomic structure, ionic and covalent bonding, reaction energetics, intermolecular forces, precipitation reactions, acid/base reactions, oxidation/reduction processes, and introductions to organic and inorganic chemistry.

Prereq: One yr of high school chemistry and successful completion of the Chem Placement Exam or Chem Modules Exam, or completion of CH 111 w/ C- or better. Coreq: CH 102. ADD BOTH CH 101 and CH 102 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 102 General Chemistry Laboratory (1 credit hours)
Laboratory experience to accompany CH 101. Introduction to basic laboratory equipment and skills.

Corequisite: CH 101
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 103 General Chemistry I for Students in Chemical Sciences (3 credit hours)
A study of the structure of atoms and the periodic trends of the elements, chemical bonding, the spatial and electronic structure of molecules, chemical reactions, quantification of materials and reactions, energy changes of reactions, and properties of gases. First half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 101 and CH 103.

Prerequisites: (Pass Chemistry Placement Exam, or Chemistry Placement Modules Exam, or CH 111 with a grade of C- or better) and eligibility for MA 107; Co-requisite: CH 104
GEP Natural Sciences
Typically offered in Fall only

CH 104 General Chemistry Laboratory I for Students in Chemical Sciences (1 credit hours)
Laboratory and computer-based experiments in chemical formulas, atomic structure, bonding, qualitative analysis, solutions, quantitative analysis of acids and bases, and calorimetry. First half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 102 and CH 104.

Co-requisite: CH 103
GEP Natural Sciences
Typically offered in Fall only

CH 111 Preparatory Chemistry (3 credit hours)
Preparation for CH101. Review of main topics from high school emphasizing nomenclature, vocabulary, the periodic table and problem solving. Emphasis on mathematical skills, data handling, reaction types, stoichiometry and solutions. Credit for CH 111 is not allowed if a student has prior credit in CH 101. Credit for CH 111 does not count towards graduation for students in curricula that require CH 101.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 201 Chemistry - A Quantitative Science (3 credit hours)
Detailed quantitative aspects of solutions, solution stoichiometry, thermodynamics, chemical equilibrium, acid-base equilibria, solubility equilibria, electrochemistry, chemical kinetics, and nuclear chemistry.

Prerequisite: CH 101 with grade C- or better, CH 102, and eligibility for MA 121 or higher, Corequisite: CH 202
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 202 Quantitative Chemistry Laboratory (1 credit hours)
Laboratory experience to complement CH 201. Experimental exploration of thermodynamic, kinetic, and electrochemical behavior.

Prerequisite: CH 101, CH 102, Corequisite: CH 201
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CH 203 General Chemistry II for Students in Chemical Sciences (3 credit hours)
A study of intermolecular forces between molecules, and their affect on the properties of solids, liquids and gases, and on phase changes. The interplay of energetics and chemical kinetics on equilibria, including gas phase, acid-base, redox, and solubility equilibria. Second half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 201 and CH 203.

Prerequisites: (CH 101 with a minimum of 3 grade points or CH 103), and (CH 102 or CH 104), and eligibility for MA 131 or higher; Co-requisite: CH 204
GEP Natural Sciences
Typically offered in Spring only

CH 204 General Chemistry Laboratory II for Students in Chemical Sciences (1 credit hours)
Laboratory experiments in solid state materials, preparation and analysis of an organic compound, separations, gases, solutions, equilibrium, acids and bases, and kinetics. Second half of a two semester sequence for students interested in a chemistry or closely related career. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCCHM majors and to students with departmental approval. Students cannot receive credit for both CH 202 and CH 204.

Prerequisite: CH 104 with a minimum of C-. Co-requisite: CH 203
GEP Natural Sciences
Typically offered in Spring only

CH 220 Introductory Organic Chemistry (3 credit hours)
A one-semester course in the fundamental principles of organic chemistry. Preparation, reactions, and physical properties of alkanes, cycloalkanes, alcohols, alkyl halides, aromatic compounds, aldehydes, ketones, organic acids, acid derivatives, and amines. Credit is not allowed for both CH 220 and CH 221.

Prerequisite: CH 101. Corequisite: CH 222.
Typically offered in Fall, Spring, and Summer

CH 221 Organic Chemistry I (3 credit hours)
First half of two-semester sequence in the fundamentals of modern organic chemistry. Structure and bonding, stereochemistry, reactivity and synthesis of carbon compounds. Detailed coverage of aliphatic hydrocarbons, alcohols, ethers, and alkyl halides. Introduction to spectral techniques of IR, UV-vis, and NMR. Students cannot receive credit for both CH 221 and CH 225.

Prerequisite: CH 101 with a grade of C- or better and CH 102; Corequisite: CH 222
Typically offered in Fall, Spring, and Summer

CH 222 Organic Chemistry I Lab (1 credit hours)
Laboratory experience to accompany CH 220 or CH 221. Introduction to basic organic laboratory equipment and techniques. Students cannot receive credit for both CH 222 and CH 226.

Prerequisite: CH 101 and CH 102; Corequisite: CH 220 or CH 221
Typically offered in Fall, Spring, and Summer

CH 223 Organic Chemistry II (3 credit hours)
Second half of two-semester sequence in the fundamentals of modern organic chemistry. Structure and bonding, stereochemistry, reactivity and synthesis of carbon compounds. Detailed coverage of aromatic hydrocarbons, condensation reagents, and selected biological chemistry topics such as carbohydrates, lipids, and amino acids. Students cannot receive credit for both CH 223 and CH 227.

Prerequisite: CH 221 with a grade of C- or better and CH222; Corequisite: CH 224
Typically offered in Fall, Spring, and Summer

CH 224 Organic Chemistry II Lab (1 credit hours)
Laboratory experience to accompany CH 223. Introduction to basic organic laboratory equipment and techniques. Students cannot receive credit for both CH 224 and CH 228.

Prerequisite: CH 221 and CH 222; Corequisite: CH 223
Typically offered in Fall, Spring, and Summer

CH 225 Organic Chemistry I for Students in Chemical Sciences (3 credit hours)
First half of a two semester sequence in organic chemistry for students interested in a chemistry or closely related career. Structure and bonding, stereochemistry, reactivity and synthesis of aliphatic hydrocarbons, alcohols, ethers and alkyl halides. Introduction to IR, NMR, and mass spectral techniques. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI, and 17MARSCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 221 and CH 225.

Prerequisites: (CH 201 or CH 203) and (CH 202 or CH 204); Co-requisite: CH 226
Typically offered in Fall only

CH 226 Organic Chemistry Laboratory I for Students in Chemical Sciences (1 credit hours)
First half of a two semester laboratory sequence in organic chemistry for students interested in a chemistry or closely related career. Laboratory experiments in the determination of physical properties of organic compounds, separation of mixtures and purification of compounds, synthesis and spectroscopic characterization of organic compounds, and the execution of a multi-step synthesis. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARSCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 222 and CH 226.

Co-requisite: CH 225
Typically offered in Fall only

CH 227 Organic Chemistry II for Students in Chemical Sciences (3 credit hours)
Second half of a two semester sequence in organic chemistry for students interested in a chemistry or other closely related career. Structure and bonding, stereochemistry, reactivity and synthesis of aromatic compounds. Condensation reactions and organic compounds of biological interest. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARSCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 223 and CH 227.

Prerequisites: (CH 221 B or better or CH 225) & (CH 222 or CH 226); Corequisite: CH 228; Restricted to:17CHEMBS, 17CHEMBA, 14CHEI, 14CHEBS, 11BIOCHBS, or 17MARSCHM majors or dept approval. Students cannot receive credit for both CH 223 and CH 227.
Typically offered in Spring only

CH 228 Organic Chemistry Laboratory II for Students in Chemical Sciences (1 credit hours)
Second half of a two semester laboratory sequence in organic chemistry for students interested in a chemistry or closely related career. Laboratory experiments in multi-step organic synthesis, identification and characterization of compounds by spectroscopic methods. Searching the chemical literature. This course is open to 17CHEMBS, 17CHEMBA, 14EFY-14CHEI, 14CHEBS, 11BIOCHBS, 11LSFY-11BCHI and 17MARSCBS-17MARSCHM majors and to students with departmental approval. Students cannot receive credit for both CH 224 and CH 228.

Co-requisite: CH 227
Typically offered in Spring only

CH 230 Computational Chemistry Lab I (1 credit hours)
An introduction to computational methods in the chemical sciences. A quantitative introduction to inter- and intramolecular forces in gas and condensed phases. Potential energy surfaces of molecules and chemical reactions. First of a two-semester sequence.

Prerequisite: CH 221 or CH 225: Co-requisite: MA 241
Typically offered in Fall only

CH 232 Computational Chemistry Lab II (1 credit hours)
An introduction to computational methods in the chemical sciences. A computer-based introduction to quantum mechanics, including atomic and molecular orbitals and molecular orbital theory with applications to inorganic chemistry.

Prerequisite: CH 221 or CH 225, Corequisite: MA 241
Typically offered in Spring only

CH 295 Special Topics in Chemistry (1-3 credit hours)
Special topics in chemistry at the early undergraduate level. Trial offerings of new or experimental courses in chemistry. Enrollment requires permission of the department.

Typically offered in Fall, Spring, and Summer

CH 315 Quantitative Analysis (3 credit hours)
Introduce the fundamental principles and modern techniques of chemical analyses. This includes examination of electrolytic solutions, including acid-base, oxidation-reduction, and solubility equilibria, and introduction to spectrochemical, electrochemical, volumetric and chromatographic methods of analysis, modern chemical instrumentation, and interpretation of data.

Prerequisite: (CH 201 or CH 203) with a grade of C- or better, Co-requisite: CH 316
Typically offered in Fall, Spring, and Summer

CH 316 Quantitative Analysis Laboratory (1 credit hours)
Application of spectrochemical, electrochemical, volumetric, and chromatographic methods of analysis for the identification and quantification of components in a mixture.

Prerequisite: (CH 201 or CH 203) and (CH 202 or CH 204); Corequisite: CH 315
Typically offered in Fall, Spring, and Summer

CH 331 Introductory Physical Chemistry (4 credit hours)
Fundamental physiochemical principles including chemical thermodynamics, physical and chemical equilibrium, electrochemistry and reaction kinetics. For students requiring only a single semester of physical chemistry.

Prerequisite: (CH 201 or CH 203) and (CH 202 and 204) and (MA 231 or 241) and (PY 205 or PY 211)
Typically offered in Fall, Spring, and Summer

CH 335/PSE 335 Principles of Green Chemistry (4 credit hours)
Introduction to the topic of green chemistry as an emerging field; Identification of hazards and classes; overview of sources; alternative solvents and reagents; sustainability of chemical reactions; alternative chemical reactions and pathways; alternative feedstocks; enzymatic catalysis; ionic liquids; re-engineering of chemical processes; chemical synthesis.

Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/22 (or equivalent)
Typically offered in Fall only

CH 345 Chemistry and War (3 credit hours)
This course will cover the influence of chemical discoveries on major military conflicts, from World War I to the present, as well as the effect that military conflicts during this time had on chemical discoveries. Topics will include but are not limited to: explosives, chemical weapons, nuclear weapons, military medicine, and chemical/biological weapons detection.

Prerequisites: CH 223 or CH 227
GEP Interdisciplinary Perspectives
Typically offered in Spring only

CH 401 Systematic Inorganic Chemistry I (3 credit hours)
Descriptive chemistry of the elements with particular attention to their reactions in aqueous solution. Emphasis on the chemistry of the main group elements and the periodicity of their chemical properties. Introduction to transition element and coordination chemistry. Major paper required.

Prerequisite: (CH 201 or CH 203) with grade of C- or better.
Typically offered in Fall and Spring

CH 403 Systematic Inorganic Chemistry II (3 credit hours)
Development and application of theoretical principles to the structure and energies of inorganic substances. Particular attention to the chemistry of coordination compounds of the transition elements. Special applications to bioinorganic chemistry,organometallic chemistry, and inorganic solid state chemistry.

Prerequisite: CH 401, CH 431
Typically offered in Fall and Spring

CH 415 Analytical Chemistry II (3 credit hours)
Methods of quantitative analysis based on electronic instrumentation. Signal processing and electronics, spectroscopy (atomic, x-ray fluorescence, infrared/Raman, surface), voltammetry, chromatography (gas, liquid), mass spectrometry as well as chemical transducers and statistical methods of data handling.

Prerequisite: CH 315 or PCC 412
Typically offered in Fall only

CH 431 Physical Chemistry I (3 credit hours)
Development of the basic concepts of quantum mechanics and wavefunctions as applied to atomic structure, to the translational, rotational and vibrational motion in molecules, and to molecular spectroscopy. Development of partition functions as applied to thermodynamic properties of materials. Cannot get credit for both CH 431 and CH 437.

Prerequisite: (CH 201 or CH 203) and MA 242 and (PY 203 or 208); Corequisite: MA 341
Typically offered in Fall and Spring

CH 433 Physical Chemistry II (3 credit hours)
A classical thermodynamic treatment of states of matter, activities and chemical potentials, energy changes, equilibria, and electrochemical processes. The kinetics of multi-step, catalytic and enzyme reactions.

Prerequisite: MA 341
Typically offered in Fall and Spring

CH 435 Introduction to Quantum Chemistry (3 credit hours)
An introduction to the basic principles of quantum theory and its application to atomic and molecular structure and spectroscopy.

Prerequisite: CH 431
Typically offered in Spring only

CH 437 Physical Chemistry for Engineers (4 credit hours)
Selected physiochemical principles including quantum theory, spectroscopy, statistical thermodynamics, and rates of chemical reactions. Credit may not be claimed for both CH 431 and CH 437.

Prerequisite: PY 208 and CHE 315 and MA 341
Typically offered in Spring only

CH 441 Forensic Chemistry (3 credit hours)
Chemical identification (recognition), and chemical separation techniques (identification) used to demarcate class and individual characteristics relevant in legal claims.

Prerequisite: (CH 201 or CH 203) and (CH 223 or CH 227)
Typically offered in Spring only

CH 442 Advanced Synthetic Techniques (4 credit hours)
An advanced laboratory class in the synthesis, separation and characterization of organic, inorganic, and polymeric materials. Techniques include reactions under inert atmosphere, column chromatography, fractional distillations, NMR spectroscopy, and other advanced procedures. Scientific writing is emphasized.

Prerequisite: CH 223 or CH 227, Corequisite: CH 401
Typically offered in Fall and Spring

CH 444 Advanced Synthetic Techniques II (4 credit hours)
An advanced laboratory class in the synthesis, separation and characterization of organic, inorganic, polymer and materials compounds. Techniques include literature searches, reactions, under inert atmosphere, column chromatography, fractional distillations, NMR spectroscopy, and other advanced procedures. This course builds upon the skills acquired in CH 442 and has significant independent work.

Prerequisite: CH 442
Typically offered in Spring only

CH 452 Advanced Measurement Techniques I (4 credit hours)
Modern analytical and physical chemistry laboratory techniques. Emphasis on statistical methods, chemical thermodynamics, chromatography, atomic and molecular spectroscopy, report writing, scientific methodology, and laboratory safety.

Prerequisites: CH 315 and CH 316 and 431, all with grade of C- or better.
Corequisites: CH 415 and CH 433
Typically offered in Fall and Spring

CH 454 Advanced Measurement Techniques II (4 credit hours)
Advanced analytical techniques including Liquid Chromatography (HPLC), Gas Chromatography (GC), Atomic Absorption Spectroscopy (AAS), Spectrophotometry, Molecular Fluorescence, and Mass Spectrometry (MS). Physical aspects including time resolved spectrophotometric measurement of kinetics, dynamic fluorescence quenching and resonance Raman spectroscopy. Students will also participate in carrying out a project through consultation with the instructor and search of the literature.

Prerequisite: CH 452 with a grade of C- or better
Typically offered in Fall only

CH 463/CH 563 Molecular Origins of Life (3 credit hours)
Survey of the present state of understanding of the molecular mechanisms leading to the emergence of sustainable self-replicating systems in the prebiotic era on the early Earth, including historical context, experimental studies, and theoretical foundation. The course will include a focus on the fundamental chemistry of and mechanisms for the plausible prebiotic formation of diverse biomolecules (including amino acids, sugars, nucleotides, lipids, tetrapyrroles) and self-organizing chemistry leading to protocells, the proposed early progenitors of living cells. Credit will not be given for both CH 463 and CH 563.

Prerequisite: BCH 351 or BCH 451 or Permission of Instructor
Typically offered in Spring only

CH 495 Special Topics in Chemistry (1-4 credit hours)
Special topics in chemistry at the advanced undergraduate level. Trial offerings of new or experimental courses in chemistry. Enrollment requires permission of the department.

Typically offered in Fall, Spring, and Summer

CH 499 Undergraduate Research in Chemistry (1-3 credit hours)
Independent investigation of a research problem under the supervision of a chemistry faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Two years of chemistry
Typically offered in Fall, Spring, and Summer

CH 563/CH 463 Molecular Origins of Life (3 credit hours)
Survey of the present state of understanding of the molecular mechanisms leading to the emergence of sustainable self-replicating systems in the prebiotic era on the early Earth, including historical context, experimental studies, and theoretical foundation. The course will include a focus on the fundamental chemistry of and mechanisms for the plausible prebiotic formation of diverse biomolecules (including amino acids, sugars, nucleotides, lipids, tetrapyrroles) and self-organizing chemistry leading to protocells, the proposed early progenitors of living cells. Credit will not be given for both CH 463 and CH 563.

Prerequisite: BCH 351 or BCH 451 or Permission of Instructor
Typically offered in Spring only

CH 572/BIT 572/BIO 572 Proteomics (3 credit hours)
Introduction and history of the field of proteomics followed by the principles and applications of proteomics technology to understand protein expression and protein post-transitional modifications. Laboratory sessions include growing yeast with stable-isotope labeled amino acids, protein purification, Western blots, protein identification and quantification, and protein bioinformatic analysis. This is a half-semester course.

Prerequisite: BIT 410 or BIT 510 or BCH 454 (or approval from the instructor)
Typically offered in Spring only

CH 601 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.

Prerequisite: Graduate standing in CH
Typically offered in Fall and Spring

CH 610 Special Topics In Chemistry (1-6 credit hours)
Detailed study of a particular problem or technique pertaining to chemistry.

Typically offered in Fall and Spring

CH 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall only

CH 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Summer only

CH 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CH 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CH 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CH 701 Advanced Inorganic Chemistry I: Structure and Bonding (3 credit hours)
Study of periodic table/trends, symmetry and molecular orbital theory of small molecules and extended structures, transition-metal coordination complexes, acid/base and redox reactivity of polyatomic ions, solid-state structures, and selected special topics.

Typically offered in Fall only

CH 703 Advanced Inorganic Chemistry II: Applications of Group Theory to Bonding and Spectroscopy (3 credit hours)
This course uses group theory as the basis for developing molecular orbital theory, vibrational spectroscopy, and electronic spectroscopy. Together, these methods are used to discuss topics of current research interest in inorganic chemistry.

Prerequisite: CH 701 or equivalent
Typically offered in Spring only

CH 705 Organometallic and Inorganic Reaction Mechanism (3 credit hours)
Coverage of concepts of bonding and structure of transition metal complexes with emphasis on the interaction of transition metal fragements with organic ligands; study of experimental methods of mechanistic study; treatment of inorganic and organometallic reactions including metal-mediated organic synthesis, metal-catalyzed polymer synthesis, and models of bioinorganic systems.

Prerequisite: Graduate standing
Typically offered in Spring only

CH 711 Advanced Analytical Chemistry I (3 credit hours)
First semester of two-semester integrated sequence covering advanced methods for extraction and interpretation of chemical information from electronic/optical signals in chemical analysis. Digital and analog electronics, signal acquisition and processing, chemometrics, and instrumentation.

Prerequisite: CH 433; CH 415
Typically offered in Fall only

CH 721 Advanced Organic Chemistry I (3 credit hours)
Introduction to physical organic chemistry. Topics include: bonding/introductory molecular orbital theory, reactive intermediates, aromaticity, pericyclic reactions, thermochemistry, linear free-energy relationships, kinetics, and transition-state theory. Topics and concepts are related to molecular reactivity and reaction mechanisms.

Prerequisite: CH 223 or CH 227 or CH 433 or CH 435
Typically offered in Fall only

CH 723 Advanced Organic Chemistry II (3 credit hours)
Introduction to acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

Prerequisite: CH 721
Typically offered in Spring only

CH 725 Physical Methods in Organic Chemistry (3 credit hours)
Application of physical methods to the solution of structural problems in organic chemistry. Methods discussed include electronic absorption spectroscopy, vibrational spectroscopy, nuclear magnetic resonance, and mass spectrometry.

Prerequisite: (CH 223 or CH 227) and CH 433 or CH 435
Typically offered in Fall only

CH 727/BIO 727 Biological Mass Spectrometry (3 credit hours)
Fundamentals of mass spectrometry including topics such as: mass, isotopic distributions, resolving power, mass accuracy. Ionization source topics: electron impact, chemical ionization, matrix-assisted laser desorption ionization, electrospray ionization and contemporary methods. Instrumentation and mass analyzers: quadrupole, time-of-flight, Fourier transform based mass analyzers; hybrid instruments such as a quadrupole orbitrap. Tandem mass spectrometry and dissociation. Applications: quantitation, small molecule analysis, and peptide sequencing.

Prerequisite: CH 223 or CH 227
Typically offered in Fall only

CH 730 Advanced Physical Chemistry (3 credit hours)
Survey of chemical thermodynamics and kinetics, with emphasis on reactions in liquid phase. Problem solving an important part of course. Designed for review and expansion on materials usually covered in a one-year undergraduate physical chemistry course.

Prerequisite: Graduate standing
Typically offered in Fall only

CH 732 Advanced Physical Chemistry in Biological Applications (3 credit hours)
Modern views on structure, function, and thermodynamic stability of biological macromolecules including proteins, nucleic acids, and biological membranes; theories and models of protein folding, high resolution experimental methods for structure determination of soluble and membrane proteins including solution and solid-state NMR spectroscopy.

Prerequisite: CH 431 or CH 433 or BCH 453 or equivalent

CH 734 Spectroscopic Methods in Chemical Biology (3 credit hours)
Physical principles underlying the experimental spectroscopic methods used to study structure and dynamics of biological macromolecules. Detailed discussion of experimental techniques include high-resolution solution Nuclear Magnetic Resonance, Electron Paramagnetic Resonance in combination with spin labeling and spin trapping methods, and fluorescence spectroscopy, including single molecule methods and fluorescence microscopy. This course is offered every third semester from Spring 2010.

Prerequisite: CH 331 or CH 431, CH 433 or equivalent

CH 735 Magnetic Resonance in Chemistry (3 credit hours)
This course is focused on physical and quantum mechanical principles that make magnetic resonance the most important spectroscopic technique in chemistry. Detailed discussion of description of magnetic resonance phenomena and NMR and EPR experimental techniques covers both classical and quantum mechanical treatments. Students of diverse backgrounds will gain in-depth knowledge of modern magnetic resonance as applied to problems in chemistry, materials, and nano-science, and biophysics.

Prerequisite: CH 331 or CH 431, CH 433 or equivalent

CH 736 Chemical Spectroscopy (3 credit hours)
Introduction to rotational, vibrational and electronic molecular spectroscopy from a quantum mechanical viewpoint. Emphasis on the elucidation of structure, bonding and excited state properties of organic and inorganic molecules.

Prerequisite: CH 435
Typically offered in Spring only

CH 737 Quantum Chemistry (3 credit hours)
Elements of wave mechanics applied to stationary energy states and time-dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

Prerequisite: MA 301, CH 435 or PY 407
Typically offered in Fall only

CH 743 Electrochemistry (3 credit hours)
Thermodynamics and kinetics of electrode reactions presented as well as experimental methods for studying them. Particular emphasis on measurement of standard potential and establishing number of electrons transferred. Applications of electrochemistry in production/storage of energy and in chemical analysis.

Prerequisite: CH 431 or CH 433
Typically offered in Spring only

CH 745 Chemical Separation (3 credit hours)
Basic principles of methods in chemical separation including gas chromatography, liquid chromatography, etc. Theory, instrumentation and applications of various chromatographic and electrophoretic techniques.

Prerequisite: CH 415, CH 416, Corequisite: CH 610 or 810
Typically offered in Fall only

CH 755 Organic Reaction Mechanisms (3 credit hours)
Effects of structure and substituents on direction and rates of organic reactions.

Prerequisite: CH 723, CH 433
Typically offered in Fall only

CH 765 Chemistry of Materials (3 credit hours)
Detailed examination of the relationship between chemical structure and physical properties of materials with potential use in applications. Different classes of molecules and materials requirements for several applications will be emphasized.

Prerequisite: CH 201 or equivalent
Typically offered in Spring only

CH 770 Bioinorganic Chemistry (3 credit hours)
The interface between inorganic and biological chemistry will be explored, focusing on the catalytic processes in metalloenzymes, and with an emphasis on the diverse roles of transition metals in biology. The physical methods required for the study of bioinorganic systems will be introduced, with application toward determining enzymatic mechanisms. Selected topics will include heme chemistry, nitrogen fixation, C-H bond activation, electron transfer, oxygen transport, metal ion uptake and toxicity, drug activation and/or metabolism by metalloenzymes, and metallodrugs.

Prerequisite: CH 401
Typically offered in Spring only

CH 772 Solid State Chemistry (3 credit hours)
Selected topics in solid-state chemistry including: extended symmetry, structure, bonding, characterizations, and special topics. Graduate standing in Chemistry required.

Prerequisite: CH 701 or equivalent
Typically offered in Spring only

CH 795 Special Topics in Chemistry (1-6 credit hours)
Typically offered in Fall and Spring

CH 801 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports on research and special problems of interest to chemists.

Prerequisite: Graduate standing in CH
Typically offered in Fall and Spring

CH 810 Special Topics In Chemistry (1-6 credit hours)
Detailed study of a particular problem or technique pertaining to chemistry.

Typically offered in Fall only

CH 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall only

CH 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall only

CH 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CH 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CH 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Civil Engineering (CE)

CE 214 Engineering Mechanics-Statics (3 credit hours)
Basic force concepts and equilibrium analysis; distributed forces; centroids; moments of inertia; application to structural elements. Credit will not be given for both CE 214 and MAE 206.

Grade of C or better in PY 205 and MA 241; Co-requisite: MA 242.
Typically offered in Fall, Spring, and Summer

CE 225 Mechanics of Solids (3 credit hours)
Elementary analysis of deformable solids subjected to force systems. Concepts of stress and strain; one, two and three-dimensional stress-strain relationships for the linear elastic solid. Statically determinate and indeterminate axial force, torsion and bending members. Stress transformations, pressure vessels, combined loadings. Introduction to column buckling.

Grade of C- or better in CE 214; MA 242.
Typically offered in Fall, Spring, and Summer

CE 250 Introduction to Sustainable Infrastructure (3 credit hours)
History and future of civil infrastructure; engineering problem solving; environmental sustainability and life-cycle assessment; social sustainability; engineering economics; problem-driven, sustainability-focused case studies related to different aspects of civil infrastructure.

CE, ENE, or CON majors only; co-requisite: CSC 111 and CE 214.
Typically offered in Fall and Spring

CE 263 Introduction to Construction Engineering (3 credit hours)
Introduction to fundamental concepts in Construction Engineering and Management including principles of project management; profit, risk, and profitability; estimating, including WBS, productivities, costs, durations, and fundamentals of equipment selection and utilization; scheduling using both CPM and Linear scheduling techniques; contract methods and control principles; professional and legal aspects of construction; fundamentals of leadership; and basic construction safety.

Corequisites: CE 214 and CE 250; R: CON Majors Only.
Typically offered in Spring only

CE 282 Hydraulics (3 credit hours)
Fluid properties; mass, energy and momentum conservation laws; dimensional analysis and modeling; laminar and turbulent flows; surface and form resistance; flow in pipes and open channels; elementary hydrodynamics; fluid measurements; characteristics of hydraulic machines. Credit will not be given for both CE 282 and MAE 308.

Prerequisite: C- or better in CE 214; Corequisites: MA 341 or MA 305 or ST 370
Typically offered in Fall, Spring, and Summer

CE 297 Current Topics in Civil Engineering (1-4 credit hours)
Presentation of material not normally available in regular course offerings, or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with Department Head.

Typically offered in Fall, Spring, and Summer

CE 301 Civil Engineering Surveying and Geomatics (3 credit hours)
Plane surveying, topographical surveying, horizontal and vertical curves, topographic surveys, construction surveys, earthwork, route surveying. Data collection using sight-based, laser-based, and global positioning system equipment. Methods for analysis and presentation of surveying and positioning data, including dealing with errors. Use and applications of GPS information. Limited to CON and CE majors. Credit will not be given for both BAE 325 and CE 301.

Junior standing; CON and CE Majors.
Typically offered in Fall and Spring

CE 305 Traffic Engineering (3 credit hours)
Integrated approach to planning, design, and operation of transportation systems with an emphasis on highway and street systems. Roadway design, traffic operations and performance, and control systems.

C- or better in CE 250; Corequisite: ST 370.
Typically offered in Fall and Spring

CE 325 Structural Analysis I (3 credit hours)
Analysis of determinate and indeterminate bars, trusses, beams and frames using the matrix displacement method. Qualitative deflected shapes and shear and bending moment diagrams. Implementation of analysis procedures through computer programming and commercial structural analysis software.

CSC 111 and C- or better in CE 225.
Typically offered in Fall and Spring

CE 327 Reinforced Concrete Design (3 credit hours)
Behavior, strength, and design of reinforced concrete members subjected to moment, shear, and axial forces. Introduction to the design of reinforced concrete structures.

Prerequisite: C- or better in CE 225
Typically offered in Fall and Spring

CE 332 Materials of Construction (3 credit hours)
Fundamental characteristics that govern material behavior. Properties of metals, ceramics, polymers, fiber reinforced composites, aggregates, portland cement concrete, and asphalt concrete. Portland cement concrete and asphalt concrete mixture designs. Materials testing according to established standards.

MSE 200 and C- or better in CE 225.
Typically offered in Fall and Spring

CE 339 Civil Engineering Systems (3 credit hours)
A broad perspective, systematic approach to civil planning, analysis, evaluation and design for large scale projects in construction, structures, transportation, water resources and other civil engineering areas.

CSC 111 and (MA 341 or MA 305); Junior standing.
Typically offered in Spring only

CE 342 Engineering Behavior of Soils and Foundations (4 credit hours)
Description, identification, and engineering classification of soils. The basic principles and mechanics of flow of water through soils, deformation and strength of soils, and the processes of consolidation and compaction. Effective stress concepts, stress and settlement analyses, and evaluation of shear strength. Methods of analysis and geotechnical engineering design concepts.

C- or better in CE 225 and CE 282.
Typically offered in Fall and Spring

CE 365 Construction Equipment and Methods (3 credit hours)
Study of construction operations as dynamic production processes. Utilization of equipment and other resources to achieve highest levels of productivity, safety, and quality. Covers a wide range of traditional and state-of-the-art construction methods.

Corequisite: CE 263 and ST 370
Typically offered in Spring only

CE 367 Mechanical and Electrical Systems in Buildings (3 credit hours)
Introduction to mechanical and electrical systems in building construction. Includes HVAC, lighting and electrical systems, focusing on design concepts, equipment application, design of the construction process, and coordination using BIM, for modern building systems.

C- or better in CE 282.
Typically offered in Spring only

CE 373 Fundamentals of Environmental Engineering (3 credit hours)
Concepts of sustainability and green engineering; energy and climate; overview of contaminants in water, air and terrestrial environments; introduction to water and wastewater treatment, air pollution control, and solid waste management.

Corequisites: CE 250 and (CHE 205 or CE 282).
Typically offered in Fall and Spring

CE 378 Environmental Chemistry and Microbiology (4 credit hours)
Principles of Environmental Chemistry and Microbiology, experimental techniques for assessing water and air quality; sampling; statistical interpretation of data.

Prerequisite: Junior standing in Environmental Engineering, MEA 323 or SSC 442, and C- or better in CE 250 and CE 373; Corequisite: ST 370.
Typically offered in Fall only

CE 381 Hydraulics Systems Measurements Lab (1 credit hours)
Introduction to experimental techniques for the analysis of hydraulic systems; measurement of viscosity, fluid pressures, velocity distributions, flow rates; investigations into the friction, momentum transfer, and turbulence on fluid flow.

Corequisite: CE 282
Typically offered in Fall and Spring

CE 383 Hydrology and Urban Water Systems (3 credit hours)
Study of engineering hydrology and design of elements of urban stormwater systems. Commonly encountered applications in urban stormwater management, flood control and groundwater engineering. Familiarization with effects of watershed development on quantity and quality of streamflow.

C- or better in CE 282; Corequisite: ST 370; CE, ENE, and CON Majors.
Typically offered in Fall and Spring

CE 401/CE 501 Transportation Systems Engineering (3 credit hours)
Multi-modal transportation systems; railroads, airports, highways, and other modes. Planning, analysis, and design. Fundamental concepts; supply, demand, flows, impacts, and network optimization.

Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 402/CE 502 Traffic Operations (3 credit hours)
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 502 is not allowed.

Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 403/CE 503 Highway Design (3 credit hours)
Corridor selection; highway alignment; design of roadsides, intersections, and interchanges. Completion of research paper for students taking course for graduate credit. Credit will not be given for both CE 403 and CE 503.

Prerequisite: C- or better in CE 305
Typically offered in Spring and Summer

CE 405/CE 505 Railroad System Planning, Design, and Operation (3 credit hours)
Students will learn about railroad technology and how to plan, design, and operate rail systems especially the design of alignments, track, and terminals; and the operation of freight and passenger services (ranging from transit through commuter rail to intercity and high speed rail). Field trips are involved during non-scheduled class time. Students must be able, if necessary, to provide their own transportation.

Prerequisite: CE 305
Typically offered in Spring only

CE 413 Principles of Pavement Design (3 credit hours)
Basic principles of analysis, design and performance of highway and airport pavements with critical evaluation of current design and maintenance strategies.

CE 332 and CE 342
Typically offered in Fall only

CE 420 Structural Engineering Project (3 credit hours)
Planning, analysis and design of complete structural systems composed of steel and reinforced concrete. Professional topics in structural engineering practice.

C- or better in CE 325 and CE 327 and CE 342 and CE 426.
Typically offered in Fall and Spring

CE 426 Structural Steel Design (3 credit hours)
Design and behavior of structural steel members and their connections subjected to moment, shear, and axial forces. Introduction to the design of steel structures.

C- or better in CE 225.
Typically offered in Fall, Spring, and Summer

CE 435 Engineering Geology (3 credit hours)
Application of both geology and geotechnical engineering to engineering projects. Illustrations of relevant materials properties and techniques utilized in describing subsurface conditions.

Prerequisite: MEA 101 and Junior standing in colleges of Agriculture and Life Sciences, Engineering, Natural Resources, College of Sciences or Textiles
Typically offered in Spring only

CE 437 Civil Engineering Computing (3 credit hours)
Computational approaches to modeling with applications in construction, structures, transportation, water resources and other civil engineering areas; matrix computations, digital terrain modeling, network applications and algorithms, heuristic optimization.

Senior standing; CSC 111 and (MA 341 or MA 305).
Typically offered in Fall only

CE 443 Seepage, Earth Embankments and Retaining Structures (3 credit hours)
Review of shear strength concepts; ground water hydraulics; slope stability; lateral earth pressure problems; placement of fills.

C- or better in CE 342.
Typically offered in Spring only

CE 444 An Introduction to Foundation Engineering (3 credit hours)
This course will cover the basics of subsurface analysis and foundation design. Subsurface analysis includes the planning and interpretation of site investigation programs, including insitu testing and sampling, and laboratory testing and data interpretation. Foundation design will include the study of shallow and deep foundations subject to a combination of vertical and lateral loads.

C- or better in CE 342.
Typically offered in Fall only

CE 450 Civil Engineering Project (3 credit hours)
Integrated multi-disciplinary team approach to large-scale civil engineering design including topics from geotechnical engineering, land development, transportation engineering, and water resources engineering. Professional topics in civil engineering practice and ethics.

Prerequisite: CE 305 & CE 342 & CE 383; Corequisite: one of (CE 403, CE 413, CE 443, CE 444, or CE 488).
Typically offered in Fall and Spring

CE 463 Construction Estimating, Planning, and Control (3 credit hours)
Overview of the construction industry; life cycle of construction projects, work breakdown structure, activity cost and time estimation, computerized planning and scheduling methods, resource leveling, time-cost tradeoff; computerized cost estimating, bidding and negotiation strategies; and cost/schedule control systems.

Prerequisite: CE 263 and CE 365 and TDE 220
Typically offered in Fall only

CE 464/CE 564 Legal Aspects of Contracting (3 credit hours)
Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationships and responsibilities; bids and contract performance, Labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism.

Prerequisite: CE 463; Corequisite: CE 365
Typically offered in Spring only

CE 466 Building Construction Engineering (3 credit hours)
Construction processes for buildings and other structures including codes and standards, structural and architectural components and systems, form work and bracing design, erection and assembly methods.

Corequisite: CE 327
Typically offered in Fall only

CE 468/CE 568 Construction Engineering Laboratory (1 credit hours)
Measurements with and calibration of measurement instruments used in construction engineering field tests for quality and safety of the construction process. Interpretation of ANSI, ASTM, ACI and AISC specifications and standards. Credit for both CE 468 and CE 568 is not allowed.

Prerequisite: CE 332, Corequisite: CE 327 or CE 426
Typically offered in Spring only

CE 469 Construction Engineering Project (3 credit hours)
Capstone course involving integrated team approach in the design of the construction process, utilizing computerized tools for cost estimation, planning, scheduling, process design, and management of two construction projects. Each student also selects an individual project. Lecture topics include: ethics, professionalism, marketing, bid presentations, business planning, finance, and other appropriate topics by guest speakers from industry.

Prerequisite: CE 463 Co-requisite: CE 464
Typically offered in Spring only

CE 476 Air Pollution Control (3 credit hours)
Introduction to air pollution control fundamentals and design. Fundamentals include the physics, chemistry and thermodynamics of pollutant formation, prevention and control. Design will include gas treatment, process modification, and feedstock modification. Pollutants to be addressed include sulfur dioxide, nitrogen oxides, particulate matter, volatile organic compounds, hydrocarbons, and air toxics. Credit for both CE 476 and CE 576 will not be given.

CE 373 and MAE 201; Corequisite: ST 370 or CHE 450 (CHE majors)
Typically offered in Fall only

CE 477 Principles of Solid Waste Engineering (3 credit hours)
Solid waste management including generation, storage, transportation, processing, land disposal and regulation. Processing alternatives including incineration and composting. Integration of policy alternatives with evaluation of engineering decisions.

CE 250, CE 282 and CE 373.
Typically offered in Spring only

CE 478/CE 578 Energy and Climate (3 credit hours)
Interdisciplinary analysis of energy technology, natural resources, and the impact on anthropogenic climate change. Topics include basic climate science, energetics of natural and human systems, energy in fossil-fueled civilization, the impact of greenhouse gas emissions on climate, and technology and public policy options for addressing the climate challenge. The course is quantitative with a strong emphasis on engineering and science.

Prerequisite: Senior standing
Typically offered in Fall only

CE 479/MEA 479 Air Quality (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the "acid rain: problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE/MEA 479 or CE/MEA 579.

CE 282 and CE 373; or CHE 311(CHE Majors); or MEA 421 (MEA Majors); Corequisite: ST 370; or ST 380 (MEA Majors)
Typically offered in Spring only

CE 481 Environmental Engineering Project (3 credit hours)
Engineering design of selected projects in environmental engineering involving interactions with other scientific and engineering disciplines. Discussion of ethical conduct and professional engineering practice.

Prerequisite: CE 378, 383 Corequisite: CE 484 and two of: CE 476, 477, 479, 488
Typically offered in Spring only

CE 484 Water Supply and Waste Water Systems (3 credit hours)
Elements of the design of water supply and wastewater disposal systems.

CE 282 and CE 373.
Typically offered in Fall only

CE 487 Introduction to Coastal and Ocean Engineering (3 credit hours)
Introduction to the analysis of civil engineering projects in the ocean and along the coastline. Basic wave mechanics, tides, and ocean dynamics as applied to the understanding of coastal erosion control and other marine problems. An optional two-day field trip to the North Carolina Outer Banks at a nominal student expense is a regular feature of the course.

Senior standing and CE 282.
Typically offered in Spring only

CE 488/CE 588 Water Resources Engineering (3 credit hours)
Extension of the concepts of fluid mechanics and hydraulics to applications in water supply, water transmission, water distribution networks and open channels to include water-supply reservoirs, pump and pipe selection, determinate and indeterminate pipe networks, and analysis of open channels with appurtenances.

Prerequisite: CE 339 and CE 383
Typically offered in Fall only

CE 493 Independent Study in Civil Engineering (1-4 credit hours)
Independent study of a topic in Civil Engineering. Topic and mode of study determined by faculty member(s) and student(s). Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

CE 497 Current Topics in Civil Engineering (1-4 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.

Typically offered in Fall, Spring, and Summer

CE 498 Special Problems in Civil Engineering (1-4 credit hours)
Directed reading in the literature of civil engineering, introduction to research methodology, seminar discussion dealing with special civil engineering topics of current interest.

Prerequisite: Senior standing
Typically offered in Fall and Spring

CE 499 Undergraduate Research Thesis in Civil, Construction and Environmental Engineering (1-3 credit hours)
Faculty mentored research related to civil, construction or environmental engineering. A plan of work is required describing the independent research culminating in a thesis. Presentation at the NC State Undergraduate Research Symposium, or other similar venue, may be included. The student must identify a research advisor from within the CCEE faculty. Departmental approval is required.

Senior standing. Departmental Approval Required.
Typically offered in Fall and Spring

CE 501/CE 401 Transportation Systems Engineering (3 credit hours)
Multi-modal transportation systems; railroads, airports, highways, and other modes. Planning, analysis, and design. Fundamental concepts; supply, demand, flows, impacts, and network optimization.

Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 502/CE 402 Traffic Operations (3 credit hours)
Highway capacity; traffic control systems; intelligent vehicle/highway systems; and other advanced topics. Credit for both CE 402 and CE 502 is not allowed.

Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 503/CE 403 Highway Design (3 credit hours)
Corridor selection; highway alignment; design of roadsides, intersections, and interchanges. Completion of research paper for students taking course for graduate credit. Credit will not be given for both CE 403 and CE 503.

Prerequisite: C- or better in CE 305
Typically offered in Spring and Summer

CE 504 Airport Planning and Design (3 credit hours)
Analysis, planning and design of air transportation facilities.

Prerequisite: C- or better in CE 305
Typically offered in Fall only

CE 505/CE 405 Railroad System Planning, Design, and Operation (3 credit hours)
Students will learn about railroad technology and how to plan, design, and operate rail systems especially the design of alignments, track, and terminals; and the operation of freight and passenger services (ranging from transit through commuter rail to intercity and high speed rail). Field trips are involved during non-scheduled class time. Students must be able, if necessary, to provide their own transportation.

Prerequisite: CE 305
Typically offered in Spring only

CE 506 Transportation Engineering Data Collection and Analysis (3 credit hours)
Broad range of transportation engineering data collection and analysis applications encompassing the modes of highway, transit and pedestrian travel and the contexts of system planning, design and operation. Proposal preparation with primary focus on methodology and work plan development for addressing important research and practice questions.

Prerequisite: CE 305, ST 370
Typically offered in Fall only

CE 507 Sensors, Instrumentation, and Data Analytics for Transportation Networks (3 credit hours)
Students will learn about the use of sensors, instrumentation, and big data analysis in transportation systems to observe, monitor, and evaluate performance. This includes the technology employed, the deployment strategies, the challenges associated with obtaining high-quality data, the fusion of data from independent sources, the imputation of missing data elements, and evaluation of performance based on the data assembled. The highway mode is the principal focus, including analyses of travel times, delays, queue dynamics, and spatial and temporal demand patterns.

Typically offered in Spring only

CE 509 Highway Safety (3 credit hours)
Methods to reduce collisions and injuries on highways. Identifying promising locations, choosing appropriate countermeasures, and evaluating past projects. Understanding the institutional context and establishing appropriate highway design standards.

Prerequisite: CE 305, Corequisite: ST 370 or equivalent
Typically offered in Spring only

CE 515 Advanced Strength of Materials (3 credit hours)
Stresses and strains at a point; rosette analysis; torsion and unsymmetrical bending of open and closed sections; nonlinear and curved beams; stress concentration; beams on elastic foundations; shear deformation of beams; classical plasticity; fracture mechanics.

Prerequisite: CE 225 or MAE 314
Typically offered in Fall only

CE 522 Theory and Design Of Prestressed Concrete (3 credit hours)
Principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexure, shear, torsion, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Application of pre-stressing to tanks and shells.

Prerequisite: CE 327
Typically offered in Fall only

CE 523 Theory and Behavior Of Steel Structures (3 credit hours)
Theory and behavior of steel structures leading to the development of design requirements contained in current specifications; flexural, torsional and flexural-torsional buckling of columns; plastic analysis of beams and frames; lateral-torsional buckling of beams; stability and strength of flat plates; beam-columns.

Prerequisite: CE 426
Typically offered in Fall only

CE 524 Analysis and Design Of Masonry Structures (3 credit hours)
Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads.

Prerequisite: CE 327
Typically offered in Spring only

CE 525 Advanced Structural Analysis (3 credit hours)
Analysis of 1D bar and beam, 2D/3D truss, and 2D/3D frame structures using the matrix displacement method. Introduction to the finite element method of analysis by deriving the element stiffness matrices and equivalent nodal loads using the Principle of Virtual Work. Derivation of Timoshenko beam elements for including shear deformation effects. Development of techniques to handle non-standard loading (e.g. support displacements, temperature changes) and accurately model member-releases. Introduction to material/geometric nonlinearity. Implementation of analysis procedures through computer programming and commercial structural analysis software.

Prerequisite: CE 325
Typically offered in Fall only

CE 526 Finite Element Method in Structural Engineering (3 credit hours)
Development of the finite element method with an emphasis on understanding the fundamental principles governing the analysis technique. Applications to two-dimensional solids with particular attention to applications in structural engineering. Typical modeling considerations are reviewed and applied to the analysis of a realistic structure.

Prerequisite: CE 515
Typically offered in Spring only

CE 527 Structural Dynamics (3 credit hours)
Analysis of single and multi-degree-of-freedom structures subjected to various types of excitations and initial conditions. Computational aspects of dynamic analysis. Introduction to approximate methods of analysis.

Prerequisite: CE 425 or CE 525
Typically offered in Spring only

CE 528/FB 528 Structural Design in Wood (3 credit hours)
Behavior, strength and design of wood structural members subjected to moment, shear and axial forces. Design of connections and introduction to design of wood structural systems.

Prerequisite: C- or better in CE 325
Typically offered in Spring only

CE 529 FRP Strengthening and Repair of Concrete Structures (3 credit hours)
Fundamental behavior of Fiber-Reinforced Polymer (FRP) strengthened/repaired reinforced concrete structures. Creation of sustainable and resilient civil infrastructure by extending the useful life of existing structures using advances materials. Applications to practical strengthening design of realistic reinforced concrete structures.

Prerequisite: CE 327 and CE 325
Typically offered in Fall only

CE 530 Properties of Concrete and Advanced Cement-Based Composites (3 credit hours)
This course consists of three parts. First part covers basic properties of cements, mineral/chemical admixtures, and concrete production. Second part covers mechanical properties including compressive and tensile strength, multi-axial loading, composite models, and fracture mechanics. Models of porosity and microstructures are also discussed. Third part covers durability and deterioration mechanisms including corrosion of steel in concrete, mass transport, service life prediction. Advanced laboratory techniques are discussed. This course also covers emerging topics such as geopolymers and aluminate cements.

Prerequisite: CE 332 and CE 225
Typically offered in Spring only

CE 536 Introduction to Numerical Methods for Civil Engineers (3 credit hours)
Introduction to widely-used numerical methods through application to civil and environmental engineering problems. Emphasis will be on implementation and application rather than the mathematical theory behind the numerical methods.

Prerequisite: MA 302, MA 341, or MA 401
Typically offered in Spring and Summer

CE 537/OR 537 Computer Methods and Applications (3 credit hours)
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.

Prerequisite: CSC 112 and (MA 341 or MA 305)
Typically offered in Fall only

CE 538 Information Technology and Modeling (3 credit hours)
Computing research and advanced technologies of interest to civil engineers. Issues in the design and development of engineering software systems and engineering modeling of structures, assemblies, processes and phenomena. Additional topics from the most predominant and recent developments and advances in civil engineering computing.

Prerequisite: CE 390
Typically offered in Fall and Spring

CE 548 Engineering Properties Of Soils I (3 credit hours)
Significant soil properties in earthwork engineering, including soil elasticity and soil mineralogy, hydraulic conductivity, stress-strain relations and shear strength, compressibility and compaction. Evaluating laboratory work including plasticity, triaxial compression, permeability, consolidation and compaction tests.

Prerequisite: CE 342
Typically offered in Fall only

CE 549 Soil and Site Improvement (3 credit hours)
Principles and design methodologies for techniques related to densification, including dynamic compaction, vibro-compaction and compaction grouting; drainage, including wick drains, horizontal drains and dewatering; physical and chemical modification, including admixtures, chemical and cement grouting, soil mixing, jet grouting and soil freezing; and use of inclusions, including stone columns, soil nailing, and meta and geosynthetic reinforcement.

Prerequisite: CE 342
Typically offered in Spring only

CE 550 Professional Engineering Communication (3 credit hours)
Communicating effectively is central to the success of any engineering project and to advance in your engineering career. In this course you will learn principles of writing clearly and effectively for the wide range of communication activities professional engineers must do for a variety of audiences. Topics covered include writing reports, writing proposals, delivering presentations, planning and revising writing, providing feedback, and more. Students will get hands-on experience working on a wide range of documents for their career.

P: Graduate Standing
Typically offered in Spring and Summer

CE 557 Engineering Measurement and Data Analysis (3 credit hours)
The course will introduce students to fundamentals of experimental design, measurement systems and applied data analysis techniques and includes 'hands-on' laboratory exercises with sensors and computer-based data acquisition. Emphasis is on general concepts and their practical application towards engineering problems. The goal of the class is to build needed background, skills and vocabulary to develop students' experimental practice rather than focusing on the underlying fundamentals of distinct areas. Students will develop more topic/media-specific knowledge through a team experimental project. Prerequisites include a course in statistics (e.g. ST 370, ST 515 or equivalent) and some coursework or experience involving scientific programming (e.g. CE 536 or 537; Matlab, Python, R, Igor Pro, IDL). Appropriate background can be determined via discussion with instructor.

Typically offered in Fall only

CE 561 Construction Project Management (3 credit hours)
Construction project management and control using network based tools, time-money analysis and other quantitative and qualitative techniques. Planning and scheduling, critical path, lead-lag, resource allocation, uncertainty, cash flow and payment scheduling, change orders, project acceleration, coordination and communication, record keeping. Emphasis on computer-based techniques.

Prerequisite: CE 463

CE 562 Lean Construction Concepts and Methods (3 credit hours)
Student teams apply concepts and methods in field studies of real project management processes and construction operations by using principles and methods in Lean Production, Construction, Design, Assembly, Supply, Production Control, and Work Process Design.

Prerequisite: CE 463
Typically offered in Fall only

CE 564/CE 464 Legal Aspects of Contracting (3 credit hours)
Legal aspects of contract documents, drawings and specifications; owner-engineer-constructor relationships and responsibilities; bids and contract performance, Labor laws; governmental administrative and regulatory agencies; torts; business organizations; ethics and professionalism.

Prerequisite: CE 463; Corequisite: CE 365
Typically offered in Spring only

CE 565 Construction Safety Management (3 credit hours)
Fundamentals of safety management principles. Detailed review of OSHA regulations and standards critical to construction engineers and managers who expect to design and administer safety related systems in a construction project. Analysis and design of example minimum safety requirements for application in construction field operations. Review of OSHA Standards for the Construction Industry, a review of selected sections of OSHA Standards for General Industry, a review of general principles of construction safety management.

Prerequisite: CE 465 or CE 466
Typically offered in Spring only

CE 566 Global Construction Engineering and Management Practices (3 credit hours)
Construction is a global business. It is common to find design simultaneously performed in different countries (24/7 design); material procured from sources around the globe; and construction performed by a workforce that is multicultural, multilingual, and multinational. Because of these characteristics those involved with this profession need to embrace this reality and become more aware of the various design and construction practices found throughout the world. This course provides students with such a global awareness by revealing construction practices and innovations found in both developed and emerging countries. To introduce this global awareness, unique construction perspectives will be offered by a consortium of universities located in China, Thailand, Africa, and the U.S. Special topic lecturers will present practices found in other parts of the world including the Middle East, Europe and Central and South America.

Restriction: Graduate standing in the Department of Civil, Construction, and Environmental Engineering unless otherwise agreed upon by instructor
Typically offered in Fall and Spring

CE 567 Risk and Financial Management in Construction (3 credit hours)
Fundamental concepts in financial and risk analysis in construction; accounting and financial metrics in construction; risk assessment and risk management in construction including the cost of risk, decision making strategies, the role of sureties, effects of risk in project delivery methods and contract types; risk effects in project financing including a review of financing sources, considerations for financing local and international projects; and the impact of financial and risk management in strategic planning in construction.

Prerequisite: ACC 220, CE 463
Typically offered in Spring only

CE 568/CE 468 Construction Engineering Laboratory (1 credit hours)
Measurements with and calibration of measurement instruments used in construction engineering field tests for quality and safety of the construction process. Interpretation of ANSI, ASTM, ACI and AISC specifications and standards. Credit for both CE 468 and CE 568 is not allowed.

Prerequisite: CE 332, Corequisite: CE 327 or CE 426
Typically offered in Spring only

CE 571 Physical Principles of Environmental Engineering (3 credit hours)
Mass balances, equation of motion for small particles, small particle interactions, particle collision/fast coagulation, partitioning, adsorption isotherms, fluid mechanics, diffusion, interphase mass transport and resistance models, elementary/non-elementary reactions, residence time distributions.

Prerequisite: CE 282, Graduate standing
Typically offered in Spring only

CE 573 Biological Principles of Environmental Engineering (3 credit hours)
Concepts in environmental microbiology including cell structure and function, phylogeny, survey of environmentally relevant microbial groups, metabolism under different redox conditions, catabolism of macromolecules, methods in microbial ecology. Relationships to engineering processes and systems will be emphasized.

Prerequisite: Graduate standing in CE, BAE, CHE, or SSC
Typically offered in Fall only

CE 574 Chemical Principles of Environmental Engineering (3 credit hours)
Inorganic and organic environmental chemistry including acid-base equilibria, precipitation, complexation, redox reactions, and natural organic matter. The role of these factors in controlling the fate of contaminants in engineered treatment systems and natural environments.

Prerequisite: Graduate standing in CE, CHE, BAE, NE, MEA, SSC
Typically offered in Fall only

CE 576 Engineering Principles Of Air Pollution Control (3 credit hours)
Introduction to air pollution control fundamentals and design. Fundamentals including physics, chemistry and thermodynamics of pollutant formation, prevention and control. Design including gas treatment and process and feedstock modification. Addressed pollutants including sulfur dioxide, nitrogen oxides, particulate matter, volatile organic compounds, hydrocarbons and air toxins. Investigation of current research. Credit for both CE 476 and CE 576 is not allowed.

Prerequisite: CE 375, CE 470, CHE 315 or MAE 301, Corequisite: ST 511 or 515
Typically offered in Fall only

CE 577 Engineering Principles Of Solid Waste Management (3 credit hours)
Solid waste management including generation, storage, transportation, processing, land disposal and regulation. Processing alternatives including incineration and composting. Integration of policy alternatives with evaluation of engineering decisions. Investigation of current research. Credit is only allowed for one of CE 477 and CE 577.

Prerequisite: CE 373
Typically offered in Spring only

CE 578/CE 478 Energy and Climate (3 credit hours)
Interdisciplinary analysis of energy technology, natural resources, and the impact on anthropogenic climate change. Topics include basic climate science, energetics of natural and human systems, energy in fossil-fueled civilization, the impact of greenhouse gas emissions on climate, and technology and public policy options for addressing the climate challenge. The course is quantitative with a strong emphasis on engineering and science.

Prerequisite: Senior standing
Typically offered in Fall only

CE 579 Principles of Air Quality Engineering (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the "acid rain" problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE/MEA 479 or CE/MEA 579.

Prerequisite: CE 373, CE 382 or CHE 311(CHE Majors), or MEA 421(MEA Majors), Corequisite: ST 370, ST 380(MEA Majors)
Typically offered in Spring only

CE 581/MEA 581 Fluid Mechanics in Natural Environments (3 credit hours)
Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Review of fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications. Topics and examples include waves, instability, stratification, turbulent boundary layers, jets and plumes, and open channel flows. Cannot receive credit for both CE 581 and MEA 581.

Prerequisite: CE 282 or MEA 463 or permission of instructor
Typically offered in Fall only

CE 582 Coastal Hydrodynamics (3 credit hours)
This course gives an introduction to water wave mechanics for engineers and scientists. Topics include wave generation, propagation, kinematics, transformation, breaking, forces, and dissipation.

Prerequisite: CE 282 or permission of instructor.
Typically offered in Spring only

CE 583 Engineering Aspects Of Coastal Processes (3 credit hours)
Coastal environment, engineering aspects of mechanics of sediment movement, littoral drift, beach profiles, beach stability, meteorological effects, tidal inlets, inlet stability, shoaling, deltas, beach nourishment, mixing processes, pollution of coastal waters, interaction between shore processes and man-made structures, case studies.

C- or better in CE 282.
Typically offered in Spring only

CE 584 Hydraulics Of Ground Water (3 credit hours)
Introduction to ground water hydraulics and hydrology. Hydrologic cycle, basic ground water hydraulics, numerical solution of governing equations, ground water hydrology of North Carolina, well design and construction, flow net development, and ground water contamination sources.

Prerequisite: CE 382
Typically offered in Fall only

CE 585 Principles of Surface Water Quality Modeling (3 credit hours)
This course addresses how human inputs affect natural and engineered aquatic systems, through mathematical modeling of system dynamics. Course topics integrate physical, chemical, and biologic processes related to pollutants and lower food-web dynamics. Lectures and assignments cover both theory and application. Applications are relevant to informing management, protection, and restoration of inland and coastal waters.

Prerequisite courses include environmental processes (e.g., CE 373) and quantitative calculus-based hydrology (e.g., CE 383), or permission of instructor.
Typically offered in Spring only

CE 586 Engineering Hydrology (3 credit hours)
Hydrologic principles underlying procedures for surface water modeling; applications of common hydrologic models to actual watersheds.

Prerequisite: CE 383
Typically offered in Fall only

CE 588/CE 488 Water Resources Engineering (3 credit hours)
Extension of the concepts of fluid mechanics and hydraulics to applications in water supply, water transmission, water distribution networks and open channels to include water-supply reservoirs, pump and pipe selection, determinate and indeterminate pipe networks, and analysis of open channels with appurtenances.

Prerequisite: CE 339 and CE 383
Typically offered in Fall only

CE 590 Special Topics In Civil Engineering (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 591 Special Topics in Civil Engineering Computing (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 592 Special Topics in Construction Engineering (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 593 Special Topics in Geotechnical Engineering (1-3 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 594 Special Topics in Structures and Mechanics (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 595 Special Topics in Transportation Engineering (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 596 Special Topics in Water Resource and Environmental Engineering (1-6 credit hours)
New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 603 Construction Engineering Seminar (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.

Typically offered in Fall and Spring

CE 605 Structures and Mechanics Seminar (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.

Typically offered in Fall and Spring

CE 607 Water Resource and Environmental Engineering Seminar (1 credit hours)
Discussions and reports of subjects in civil engineering and allied fields.

Typically offered in Fall and Spring

CE 610 Special Topics CE (1-6 credit hours)

CE 635 Advanced Reading In Civil Engineering (1-3 credit hours)
Directed reading of advanced topics in some phase of civil engineering.

Prerequisite: Graduate standing
Typically offered in Summer only

CE 675 Civil Engineering Projects (1-6 credit hours)
Research- or design-oriented independent study and investigation of a specific civil engineering topic, culminating in final written report.

Typically offered in Fall, Spring, and Summer

CE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CE 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Summer only

CE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Summer only

CE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Summer only

CE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Summer only

CE 701 Urban Transportation Planning (3 credit hours)
Planning and design of urban transportation systems as related to comprehensive urban planning; principles of land use planning, urban thoroughfare planning and regional planning

Prerequisite: CE 501
Typically offered in Spring only

CE 702 Traffic Flow Theory (3 credit hours)
Stream flow, shock wave, queuing, and other macroscopic theories;car following, gap acceptance, and other microscopic theories; distributions of traffic stream parameters; building traffic simulation models.

Prerequisite: CE 502, Corequisite: ST 370
Typically offered in Fall only

CE 703 Economic Analysis of Transportation Systems (3 credit hours)
Transportation economics in terms of its supply and demand, costs, pricing, and regulation, especially the way in which the theory of economics in the marketplace and for public and private firms applies to the transportation market given its unique characteristics.

Typically offered in Fall only

CE 705 Intelligent Transportation Systems (3 credit hours)
Intelligent Transportation Systems (ITS) planning and human factor elements; application of monitoring, communications and information dissemination technologies to transportation systems; advanced traffic management for freeway and arterial systems; traveler information and public transportation systems; automated vehicle and highway systems. ITS evaluation methods and models.

Prerequisite: CE 501 and CE 502
Typically offered in Fall only

CE 706 Advanced Traffic Control (3 credit hours)
Advanced signalized traffic control methods at intersections, arterials and networks. Applications of mathematical optimization techniques to signal timing and coordination. Use of traffic simulation and optimization models for signal evaluation and design. Roundabout analysis and design.

Prerequisite: CE 502
Typically offered in Spring only

CE 707 Transportation Policy and Funding (3 credit hours)
Understanding and debating important current transportation policy issues in the U.S. Raising and allocating funds for building and maintaining the transportation system. Highway, public transit, rail, air, and other modes.

Prerequisite: CE 501 or graduating in Economics or Public Administration
Typically offered in Spring only

CE 708 Transportation Logistics Planning and Optimization (3 credit hours)
The mathematical treatment of transportation logistics from the perspective of infrastructure providers and system operators, including models used by freight service providers to determine how they will meet the demands for freight service. Private and common carrier operations are covered. Rail, truck, and air are the primary modes examined.

Typically offered in Fall only

CE 714 Stress Waves (3 credit hours)
Theory of stress waves in solids. Origins and nature of longitudinal transverse and surface waves originating at an impact site or from other transient disturbances. Determination of stresses, particle velocities, wave velocities. Wave interaction with other waves and with boundaries and dissimilar materials. Modern instrumentation and seismic refraction exploration.

Prerequisite: MA 341; CE 225 or PY 411 or MA 401
Typically offered in Fall only

CE 718 Constitutive Modeling of Engineering Materials (3 credit hours)
Stresses and strains (vectors, tensors and indicial notations), general theorems for elastic-plastic solids, constitutive modeling of metals and concrete, numerical implementations of plasticity models.

Prerequisite: CE 515 (old CE 715)
Typically offered in Spring only

CE 721 Matrix and Finite Element Structural Analysis (3 credit hours)
Advanced topics in matrix structural analysis and finite element method. Introductory review of the method, isoparametric quadrilateral element and three-dimensional elements. Energy methods and convergence criteria. Higher order elements. Isoparametric beam and plant elements, shear locking. Isoparametric curved beam and shell elements. Axisymmetric elements, Fourier series load and displacement representation. Analysis of systems with geometric and material nonlinearities.

Prerequisite: CE 526
Typically offered in Spring only

CE 723 Advanced Structural Dynamics (3 credit hours)
Finite element formulation of equations of motion; advanced analysis techniques for discrete parameter systems; investigation of damping; analysis of continuous systems; applications to civil engineering structures.

Prerequisite: CE 527
Typically offered in Fall only

CE 724 Probabilistic Methods Of Structural Engineering (3 credit hours)
Application of probability theory and stochastic processes to study safety of structures. Fundamentals of probability theory and stochastic processes; probabilistic modelings of structural loadings, material properties and risk. Reliability analysisof structures; reliability-based design criteria. Random vibration of simple structures; safety analysis of structures under dynamic loads.

Prerequisite: MA 421
Typically offered in Fall only

CE 725 Earthquake Structural Engineering (3 credit hours)
Effects of earthquakes on structures and of design of structures to resist earthquake motions; earthquake mechanisms and ground motions; response of structures to earthquake motions; behavior of materials, structural elements and assemblages subjected to earthquakes; principles of earthquake-resistant design practice; soil-structure interaction; and special topics.

Prerequisite: CE 527
Typically offered in Fall only

CE 726 Advanced Theory Of Concrete Structures (3 credit hours)
Inelastic theory of structural concrete members under flexure, axial load, combined flexure and axial compression, shear and torsion. Yield line theory of slabs. Limit analysis of beams and frames of reinforced and prestressed concrete.

Prerequisite: CE 522
Typically offered in Spring only

CE 727 Seismic Analysis, Assessment, and Design of Concrete Buildings (3 credit hours)
This course covers the seismic analysis, assessment and design of concrete building structures. The progression through the course follows four areas, namely: Concrete non-linear material behavior; Frame analysis and design; Wall analysis and design; assessment and retrofit. The emphasis during the course will be on the relationships between engineer's choices, analysis and design.

P: CE 725 or equivalent
Typically offered in Spring only

CE 728 Performance Based Seismic Design of Bridges (3 credit hours)
This course covers the seismic analysis and design of bridge structures. The progression through the course follows six thematic areas, namely: Conceptual design; Analysis approaches; Capacity Design; Response Verification; Assessment and Retrofit of Bridges; and New (or underutilized) frontiers in bridge engineering. The emphasis during the course will be on the relationships between engineer's choices, analysis, and design.

Prerequisite: CE 725
Typically offered in Spring only

CE 730 Mechanics and Failure of Quasi-Brittle Materials (3 credit hours)
This course is in three parts. Part one covers fundamentals of composites including estimating the mechanical and thermomechanical properties, failure of composites, laminate, and shear-lag model. Advanced topics including homogenization theories, Eigenstrain and Eigenstress, dilute, self-consistent and Mori-Tanaka methods are also covered. Part two covers fundamental of fracture mechanics including Griffith theory, stress field at crack tip, energy release rate, crack tip plasticity, and mixed mode fracture. Part three covers interface cracks, cracks approaching an interface, and fracture of composites.

Prerequisite: CE 515 and Corequisite: CE526
Typically offered in Fall only

CE 737 Computer-Aided Engineering Systems (3 credit hours)
Design and implementation issues for building real-world computer-aided engineering systems. Engineering data modeling; data definition, query and manipulation methodologies; application program interfaces; problem-oriented languages and software supervisors; and knowledge-based systems to support engineering design and decision making.

Prerequisite: CE 537 or 538
Typically offered in Spring only

CE 741 Geomechanics of Stress Deformation (3 credit hours)
Concepts of volume change and effective stress, stress-strain behavior of clays and sands, stress path and failure conidtions; mechanistic interaction between solids and water, problems in elasticity and plasticity pertaining to stress distribution, elstic, consolidation and secondary settlements, and tolerance limits to deformation levels.

Prerequisite: CE 440, or CE 443 or CE 548

CE 742 Deformation and Instability of Soils (3 credit hours)
Deformation and failure of soils. Limit equilibrium analyses for: slope stability, lateral earth pressure, bearing capacity of shallow foundations. Constitutive models for soils. Linear elasticity and theory of plasticity. Critical state model for soil behavior. Limit analysis.

Prerequisite: CE 440, or CE 443 or CE 548

CE 744 Foundation Engineering (3 credit hours)
Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction.

Prerequisite: CE 342
Typically offered in Spring only

CE 746 Soil Dynamics and Earthquake Engineering (3 credit hours)
Dynamics of discrete and continuous systems with application to soil dynamics: dynamic soil properties, analysis of foundation vibration, construction-induced vibration, dynamic soil-structure interaction. Geotechnical earthquake engineering: ground motion characteristics, dynamic response of soil sites, effect of local site conditions on design ground motion, liquefaction of soils.

Prerequisite: CE 440, or CE 443 or CE 548

CE 747 Geosynthetics in Geotechnical Engineering (3 credit hours)
Introduction to use, manufacturing techniques, design and construction of geosynthetics in geotechnical engineering applications; design and analysis of geotextiles, geonets, geogrids and geomembranes in pavements base and subbase reinforcement, reinforced walls, slopes, moisture barriers, dams and hazardous impoundment, landfill liners and covers.

Prerequisite: CE 548
Typically offered in Spring only

CE 751 Theory Of Concrete Mixtures (3 credit hours)
In-depth study of theory of portland cement concrete mixtures including types and properties of portland special cements; chemical reactions; brief examination of history of mixture design; detailed study of current design methods; properties of fresh and hardened concretes; strength-age-curing relationships; durability; admixtures; special concretes; production and quality control.

Prerequisite: CE 332
Typically offered in Fall only

CE 755 Highway Pavement Design (3 credit hours)
Theoretical analysis and design of highway pavements with critical evaluation of current design practices. Pavement materials characterization; stresses and strains in pavements; traffic consideration; pavement performance models; and actual thickness design of pavements using different methodologies.

Prerequisite: CE 342
Typically offered in Fall only

CE 757 Pavement Management Systems (3 credit hours)
Fundamental concepts in process of pavement management at both network level and project level. Distress identification and evaluation; concepts and methods for rehabilitation and maintenance techniques; nondestructive testing of pavements; performance prediction models; and principles of prioritization/optimization.

Prerequisite: CE 755
Typically offered in Spring only

CE 758 Multiscale Characterization of Asphalt Materials (3 credit hours)
Multiscale characterization of asphalt concrete. Chemical, rheological, and damage characterization of asphalt binder; asphalt binder oxidative aging; asphalt modification; asphalt emulsions; asphalt mastics; fine aggregate matrix; coarse aggregate structure. Graduate course on Asphalt and Bituminous Materials or consent by the instructor.

Typically offered in Spring only

CE 759 Inelastic Behavior Of Construction Materials (3 credit hours)
Application of principles of linear and nonlinear viscoelasticity, fracture mechanics and damage mechanics to modeling inelastic behavior of construction materials. Mechanical analog of time-dependent response; linear and nonlinear elastic-viscoelastic correspondence principles; time-temperature superposition; stress intensity factor; energy release rate; J-integral; and continuum damage mechanics.

Prerequisite: CE 515
Typically offered in Spring only

CE 761 Design Of Temporary Structures in Construction (3 credit hours)
Computer-based analysis of temporary structures in construction and their design, safety and control. Emphasis on concrete formwork, falsework, earth support, cofferdams, underpinning, lifting and rigging.

Prerequisite: CE 522 or CE 744 or CE 766
Typically offered in Fall only

CE 762 Construction Productivity (3 credit hours)
Methods of collecting, assembling and analyzing construction productivity data in order to increase construction productivity. Applications of methods improvement techniques such as time-lapse photography, flow charts, process charts and time standards to improvement of construction productivity. Safety and human factors in construction and their relation to construction productivity.

Prerequisite: CE 463
Typically offered in Spring only

CE 763 Materials Management In Construction (3 credit hours)
Fundamental concepts and methods; construction specific models for integrated materials management; computer usage; vendor analysis and "best-buy;" materials requirement planning and control; management of material waste; automated materials tracking; materials handling; study of current issues; development of practical solution to a real-world problem.

Prerequisite: CE 463, CE 465
Typically offered in Spring only

CE 765 Construction Equipment Systems (3 credit hours)
Analysis of heavy construction processes as systems in order to optimize the selection and employment of construction equipment. Considerations in system design, cost and productivity estimation, operational procedures, safety and maintenance. Computer applications utilizing analytical and simulation techniques.

Prerequisite: CE 761 or 762
Typically offered in Spring only

CE 766 Building Construction Systems (3 credit hours)
Construction engineering of conventional and industrialized building systems. Emphasis in areas of structural systems utilizing cast-in-place concrete, precast concrete, prestressed concrete, structural steel, cold-formed steel, masonry, timber, composite and mixed materials. Mechanisms for resisting and transmitting loads, detailing, fabrication, transportation, erection, stability, shoring, quality control and integration of service systems.

Prerequisite: CE 466 or CE 327 or Graduate standing in ARC
Typically offered in Fall and Spring

CE 771 Physical-Chemical Water Treatment Processes (3 credit hours)
Physical-chemical treatment processes for the treatment of water, including sedimentation, flotation, filtration, coagulation, oxidation, disinfection, precipitation, adsorption, and membrane treatment processes. Current issues in drinking water quality and treatment are discussed.

Prerequisite: CE 574, Corequisite: CE 571
Typically offered in Spring only

CE 772/NE 772 Environmental Exposure and Risk Analysis (3 credit hours)
Course covers the identification, transport, and fate of hazardious substances in the environment; quantification of human exposures to such substances; dose-response analysis; and uncertainty and variability analysis. The general risk assessment framework, study design aspects for exposure assessment, and quantitative methods for estimating the consequences and probablity of adverse health outcomes are emphasized.

Prerequisite: ST 511 or 515
Typically offered in Spring only

CE 774 Environmental Bioprocess Technology (3 credit hours)
Principles of microbiological, biochemical, and biophysical processes used in environmental waste treatment and remediation processes, with particular emphasis on water quality control processes.

Prerequisite: CE 573, CE 574
Typically offered in Spring only

CE 775 Modeling and Analysis Of Environmental Systems (3 credit hours)
Movement and fate of pollutant discharges. Development and application of analytical solutions and numerical models. Role of these models in planning and management. Mathematical programming models. Alternative management strategies: direct regulation, charges and transferable discharge permits. Multiple objectives: cost, equity and certainty of outcome.

Prerequisite: CE 339 and CE 282
Typically offered in Fall only

CE 776 Advanced Water Management Systems (3 credit hours)
Application of systems analysis methods to design, analysis and management of water resources and environmental engineering.

Prerequisite: CE 339, CE 775
Typically offered in Spring only

CE 777 Stochastic Methods in Water Resources and Environmental Engineering (3 credit hours)
Stochastic modeling, water resources and environmental data analysis, Dimension reduction, estimation and detection of periodicities in water resources and environmental data, parametric and non-parametric methods in water and environmental modeling.

Prerequisite: CE 586 or ST 515
Typically offered in Spring only

CE 779 Advanced Air Quality (3 credit hours)
Local, regional and global scale chemical interactions, transport and behavior of trace gases (sulfur carbon, nitrogen, hydrocarbon, and photo-chemical oxidants) in the atmosphere. covers three primary elements of air quality: anthropogenic and natural emissions of trace gases; interactions of the pollutants in the atmosphere; and monitoring and sampling of gaseous and particulate pollutants.

Prerequisite: (CH 201 or CH 203) and MEA(CE) 479
Typically offered in Spring only

CE 784 Ground Water Contaminant Transport (3 credit hours)
Introduction to movement and attenuation of contaminants in the subsurface. Common contaminant sources; advection and dispersion; numerical modeling of contaminant transport; chemical and biological processes in the subsurface; and ground water restoration technology.

Prerequisite: CE 584 and 574
Typically offered in Spring only

CE 786 Hydroclimatology (3 credit hours)
Hydroclimatology, El-Nino southern oscillation, climate and streamflow forecasting, forecast verification measures, downscaling, Budyko's Framework, long-term water balance, data assimilation, ensemble Kalman Fiter.

Prerequisite: CE 586
Typically offered in Spring only

CE 790 Advanced Topics In Civil Engineering (1-3 credit hours)
New or special course on advanced developments in some phase of civil engineering. Specific topics and prerequisites identified for each section and varied from term to term.

Typically offered in Fall and Spring

CE 791 Advanced Topics in Civil Engineering Computing (1-3 credit hours)
Typically offered in Fall and Spring

CE 792 Advanced Topics in Construction Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 793 Advanced Topics in Geotechnical Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 794 Advanced Topics in Structures and Mechanics (1-3 credit hours)
Typically offered in Fall and Spring

CE 795 Advanced Topics in Transportation Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 796 Advanced Topics in Water Resource and Environmental Engineering (1-3 credit hours)
Typically offered in Fall and Spring

CE 803 Advanced Construction Engineering Seminar (1 credit hours)
Typically offered in Fall and Spring

CE 805 Advanced Structures and Mechanics Seminar (1 credit hours)
Typically offered in Fall and Spring

CE 807 Advanced Water Resource and Environmental Engineering Seminar (1 credit hours)
Typically offered in Fall and Spring

CE 839 Advanced Reading In Civil Engineering (1-3 credit hours)
Directed reading of advanced topics in some phase of civil engineering.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Summer only

CE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

CE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Spring and Summer

CE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CE 899 Doctoral Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Summer

College of Natural Resources (CNR)

CNR 250 Diversity and Environmental Justice (3 credit hours)
Differences between people can impact how they see one another and engage with one another. In this class we talk about those differences and address numerous facets of diversity to pique the curiosity of the students. As we learn together, we investigate content that can influence dynamics (how we feel) and we explore different ways to investigate environmental justice issues. This course is designed to create a safe learning environment for reflection, engagement, risk-taking, and the development of personal awareness while looking at how each individual can improve environmental justice. 75% of the seats will be restricted for CNR students.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

CNR 295 Special Topics in College of Natural Resources (1-3 credit hours)
Special topics in the College of Natural Resources at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

CNR 490 Senior Honors Seminar (2 credit hours)
Oral presentations of the results of the senior honors projects. Additional special seminars and group discussions to enrich and broaden student perspectives.

Prerequisite: 4 credit hours of Independent Study
Typically offered in Fall, Spring, and Summer

College of Sciences (COS)

COS 100 Science of Change (2 credit hours)
This course will examine change, both scientific and personal. Students will reflect on change in the past and looking forward as they transition to college life and scientific careers. Case studies, readings and discussions about global change topics will be used to highlight the scientific approaches of disciplines represented in the College of Sciences. In-class activities and out-of-class reflections will be used to practice skills necessary for success in college and career.

Restriction: New freshmen (NFR) in the College of Sciences only
GEP Interdisciplinary Perspectives
Typically offered in Fall only

COS 110 Exploring Issues of Diversity, Equity, and Inclusion in the Sciences (1 credit hours)
This course is designed to assist students in their successful transition to the college academic environment. Topics include academic success strategies, critical thinking, and factors that contribute to disparities in fields within science, technology, engineering and math (STEM). Students will explore their own scientific identity and examine intersections of diversity and inclusion in STEM. This course requires that participants actively explore their biases, work together to recognize systemic inequities, and examine practices that impact the way in which people interact with one another and the scientific enterprise.

Restriction: COS First Year Students
GEP U.S. Diversity
Typically offered in Fall and Spring

COS 295 Special Topics in the College of Sciences (1-3 credit hours)
Special topics in the College of Sciences at the early undergraduate level. Available as directed individual or group study.

Typically offered in Fall, Spring, and Summer

COS 498 Spec Topics in the College of Sciences 2 (3 credit hours)
Special Topics for advanced undergraduates will be selected from the mathematical, physical, and biological sciences.

Communication (COM)

COM 110 Public Speaking (3 credit hours)
Research skills, topic selection, speech organization, skills in speech delivery. Listening for analysis and evaluation of in-class speech presentation.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

COM 112 Interpersonal Communication (3 credit hours)
Interpersonal communication competence: self-concept, language and culture, self-disclosure, active listening, verbal and nonverbal communication, and conflict management.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

COM 200 Communication Media in a Changing World (3 credit hours)
Traces ongoing evolution of communication media. Examines the place and influence of the major media companies that control access to and the content of the contemporary mediascape. Challenges students to examine their use of media from cellphone, to computer, to music and gaming platforms. Restricted to non-Communication majors.

R: Non-COM majors only
GEP Humanities
Typically offered in Fall, Spring, and Summer

COM 201 Introduction to Persuasion Theory (3 credit hours)
Impacts of persuasive communication on attitudes and behavior. Uses humanistic and social scientific theories to explain the persuasive process.

Typically offered in Fall, Spring, and Summer

COM 202 Small Group Communication (3 credit hours)
Theory and practice of effective communication in small groups, including: stages of group development, role emergence, leadership functions, decision making strategies, conflict management, and the significance of power.

Typically offered in Fall and Spring

COM 211 Argumentation and Advocacy (3 credit hours)
Theory-based analysis of public argument in specialized settings of law, politics, academic debate, business and organizations, and interpersonal relations.

GEP Humanities
Typically offered in Fall, Spring, and Summer

COM 226 Introduction to Public Relations (3 credit hours)
Public relations as a communication function of organizations. Public relations process, principles, history, and practice. Analysis of environmental, organizational, communication, and audience influences on public relations practice; career opportunities.

Typically offered in Fall and Spring

COM 230 Introduction to Communication Theory (3 credit hours)
Micro- and macro-analytic theories used in the study of human communication: perspectives and assumptions of major theories; utility and application of major theories; contexts, cultures, and media.

R: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 240 Communication Inquiry (3 credit hours)
Qualitative and quantitative methods of inquiry in communication: types of questions; strategies for answering questions; nature of evidence; advantages and disadvantages of different methods; reference tolls in the field; and channels of distribution for research-based information.

Prerequisite: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 250 Communication and Technology (3 credit hours)
Examination of past, current, and future intersections of technology, culture, and communication in everyday life. Impact of communication technology policies. Analysis of communication technologies in interpersonal, organizational, societal, and global contexts. Development of technology skills for the competent communicator.

Prerequisite: Communication Majors. Credit is not allowed for both COM 250 and COM 200
Typically offered in Fall, Spring, and Summer

COM 257 Media History and Theory (3 credit hours)
Historical development and social implications of telecommunications, print, photography, film, broadcasting, and computer-mediated communication. Theoretical and methodological approaches to the field of communication media: media history; media economics and policy; media effects and power; media as producers of meaning; media audiences; media technologies; and roles of the media in social, cultural, and political change.

Prerequisite: COM 230
Typically offered in Fall and Spring

COM 267 Electronic Media Writing: Theory and Practice (3 credit hours)
Media writing as a social practice. Roles of writing and writers in media production processes. Social, political, economic, and professional conditions that enable or constrain writing and the writer. Specific media writing genres and formats. Research and preparation for media writing. Students write research-based scripts for news, commentary, and fictional genres in radio, television, film, and emerging media.

Prerequisite: COM 230
Typically offered in Fall and Spring

COM 289 Science Communication and Public Engagement (3 credit hours)
This course is an introduction to the principles and practices of communicating scientific and technological issues to public audiences, through interpersonal discussion, mass media, social media, and other means. It is open to students in all majors who want to deepen and broaden their understanding of how citizens make sense of science and technology in their everyday lives. The course features a mixture of theory-based readings and discussion with practical skill-building for communication in real-world contexts. Equal emphasis is given to humanities and social science perspectives. The application of communication concepts to controversial science contexts is emphasized, including case studies of issues such as GMOs, climate change, vaccines, and gene editing. Theoretical perspectives covered include argumentation and debate; audience analysis (through quantitative survey data and metrics); philosophy and ethics of communicating science; using narratives, framing, and metaphors to communicate science; and the cultural image of science in popular media.

GEP Humanities, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Spring only

COM 292 Language, Communication, and Culture (3 credit hours)
We use different modes of communication depending on whether we are participating in classroom discussion, talking with our parents or boss, hanging out with our friends, or visiting a different country. However, rarely do we have the opportunity to consciously reflect upon our communicative behaviors. In this class we will unpack some of the ways culture and society influence our communication, as well as how our communication affects the culture and the society in which we live. Becoming aware of the effect that our words, shared meanings, and contexts have on how we express ourselves can be the difference between positive and negative communicative experiences.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

COM 296 Communication Internship-Non-Local (1 credit hours)
Non-local directed work experience for Communication majors with supervision from the work site and the University. COM 296 may be taken more than once only with the permission of the Internship Director and the Assoc. Dept. Head. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

R: Communication Majors
Typically offered in Fall, Spring, and Summer

COM 298 Special Projects in Communication (1-3 credit hours)
A special projects course to be utilized for guided research or experimental classes at the sophomore level, topic determined by instructor.

Typically offered in Fall and Spring

COM 301 Presentational Speaking (3 credit hours)
Design, organization and delivery of oral presentations for policy determination, policy implementation, and sales.

Prerequisite: COM 110
Typically offered in Spring only

COM 304 Audio Production (3 credit hours)
Basic principles of audio production, including studio operation, performing, writing, and producing.

P: COM 267
Typically offered in Spring only

COM 316 Public Relations Writing (3 credit hours)
Communication processes and procedures of public relations programs. Media techniques, preparation of materials, channels of distribution.

Prerequisite: COM 226 and either ENG 316 or ENG 214
Typically offered in Fall and Spring

COM 321/ENG 321 Survey of Rhetorical Theory (3 credit hours)
Principles of rhetorical theory from its classical origins through the modern period to the present time. Key concepts and theories that provide a critical understanding of the processes of persuasive symbol use.

Prerequisite: Sophomore standing and above
Typically offered in Fall only

COM 322 Nonverbal Communication (3 credit hours)
Theory and research in nonverbal communication, including: environment; space; physical appearance, movement; eyes and facial expressions; and vocal cues. Nonverbal communication in personal, workplace and cross-cultural setting.

Prerequisite: COM 112
Typically offered in Fall only

COM 327 Critical Analysis of Communication Media (3 credit hours)
Theoretical frameworks, methods, and aims of various approaches to critical analysis of the media. Critiques of media production and its relation to social, economic, and technological power; social biases of informational, fictional, and hybrid media content; and historical forms of audiences and the public. Critical awareness of media's role in politics, public culture, and everyday life.

P: COM 257
Typically offered in Fall and Spring

COM 332 Relational Communication (3 credit hours)
Communication patterns in the development and deterioration of interpersonal relationships. Functional and dysfunctional communication behaviors in family relationships.

Prerequisite: COM 112
Typically offered in Fall and Spring

COM 334 Video Production (3 credit hours)
Principles of producing, directing, and editing techniques for video. Students script, storyboard, shoot, and edit short video projects.

P: COM 267 or ENG 330
Typically offered in Fall and Spring

COM 336 Newsletter Writing and Production (3 credit hours)
Newsletters are an important part of the corporate, non-profit, government, and small business portfolio of communication tools. Just about all organizations use newsletters - print or electronic - to reach their audiences with their key messages. Many young public relations practitioners start their careers working on newsletters for their organization or their clients. Students in this course will work collaboratively to write and produce a newsletter as well as other public relations publications.

Typically offered in Fall and Spring

COM 342 Qualitative Research Methods in Communication (3 credit hours)
Introduction to qualitative methods in communication research. Research paradigms, research ethics, research design, qualitative data collection, data analysis and interpretation, written and multimedia reporting of research results. Students are responsible for providing their own transportation to research sites for fieldwork.

Prerequisite: COM 240
Typically offered in Fall and Spring

COM 346 Case Studies in Public Relations (3 credit hours)
Application of theory, principles, and problem-solving techniques used in public relations to organizational case studies.

Prerequisite: COM 226 and COM 230
Typically offered in Fall and Spring

COM 354 Critical Media Making (3 credit hours)
Production lab and seminar combined. Critical making of visual images, audio, and video for the web and other electronic platforms informed by theories of visual communication and digital culture. Critical analysis of the assumptions underlying the development and deployment of media, and their social, economic, and political impact. Development of practical skills and critical thinking.

P: COM 267
Typically offered in Fall and Spring

COM 362/WGS 362 Communication and Gender (3 credit hours)
Effects of gender on the interpersonal communication process. Construction of gendered identities via communication practices. Examination of theories of gender and the role of gender in organizational, institutional, and media communication practices.

Prerequisite: Junior standing, COM 112
Typically offered in Fall only

COM 364/ENG 364 History of Film to 1940 (3 credit hours)
Technological developments and aesthetic movements that shaped international cinema production from the beginning of the industry to 1940. Formal evolution in camera movement, editing, sound, narrative form, and the documentary. The rise to prominence of Hollywood and international cinemas in historical, economic, and cultural contexts.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

COM 374/ENG 374 History of Film From 1940 (3 credit hours)
Technological developments and aesthetic movements that have shaped international cinema production from 1940 to the present. Evolution in camera movement, editing, sound, narrative form, and the documentary. Post-war Hollywood cinema and international film industries (both established and emerging) in historical, economic and cultural context.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

COM 384 Television Production (3 credit hours)
Basic techniques of television studio production, including producing, writing, directing and electronic graphics production.

P: COM 267
Typically offered in Fall and Spring

COM 386 Quantitative Communication Research Methods (3 credit hours)
Design and implementation of communication research methods, including experimental and survey research procedures. Use of computer software for statistical analysis.

Prerequisite: COM 240
Typically offered in Fall, Spring, and Summer

COM 392/HSS 392 International and Crosscultural Communication (3 credit hours)
Patterns and problems of verbal and non-verbal forms of crosscultural communication. Avoidance and management of cultural conflict arising from awareness of characteristics and crosscultural communication. Impact on communication of differing cultural perspectives.

GEP Global Knowledge, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

COM 395/ENG 395 Studies in Rhetoric and Digital Media (3 credit hours)
Study of the influence of emerging technologies on rhetorical theory and practice. Rhetorical analysis of texts, including visual and audio texts. Invention and construction of digital media texts as a means of engaging rhetorical theory and analysis. Topics vary to adapt to emerging technologies and changing vernacular practices.

Prerequisite: ENG 101
GEP Humanities
Typically offered in Fall and Spring

COM 402 Advanced Group Communication (3 credit hours)
Communication processes and outcomes in groups with complex, strategic, and critical public or corporate functions. Focus on participating in, intervening in, leading, and constructing group processes. Advanced theory with application.

Prerequisite: COM 202
Typically offered in Spring only

COM 404 Advanced Audio Production (3 credit hours)
Advanced multichannel techniques for audio production. Studio acoustics, audio signal processing, and advanced microphone techniques, writing, and performing.

P: COM 307
Typically offered in Fall only

COM 411/ENG 411 Rhetorical Criticism (3 credit hours)
Rhetorical analysis of public speeches, social movements, political campaigns, popular music, advertising, and religious communication. Neo-Aristotelian criticism, movement studies, genre criticism, dramatistic analysis, content analysis, fantasy theme analysis.

Prerequisite: Junior standing

COM 417 Communication & Race (3 credit hours)
Seminar examining the construction of racial and ethnic identities through communication practices. Exploration of theories of race and identity and the ways communication works to construct, undermine, and reinforce understanding across social groups.

GEP U.S. Diversity
Typically offered in Fall and Spring

COM 421 Communication Law (3 credit hours)
Explores the historical, philosophical, and legal foundations of communication rights and responsibilities. Philosophies and regulations affecting sources, messages, channels, receivers, and situations provide the central focus of the course.

Prerequisite: Junior standing.
Typically offered in Fall only

COM 427 Game Studies (3 credit hours)
Exploration of the social and cultural significance of digital games. Overview of major approaches and theories used in studies of digital play. Histories and current conditions of digital games platforms, practices, and industries across multiple cultural contexts. Contemporary applications of games in and across multiple domains, including education, art, sports, and work.

P: STS 214 or COM 257 or COM 250 or COM 200
Typically offered in Fall and Spring

COM 431 Communication in Political Campaigns (3 credit hours)
Roles of analysis and criticism of oral communication in political campaigns; analysis of special political communication situations; ghostwriting, news conferences, negative advertising.

Prerequisite: COM 110 or COM 201
Typically offered in Fall only

COM 434 Advanced Video Production (3 credit hours)
Hands-on experience in video production. Production of informational videos. Practical experience in all phases of the production process, including pre-production organization and critical analysis of the final product.

P: COM 334
Typically offered in Spring only

COM 436 Environmental Communication (3 credit hours)
Critical analysis of environmental discourse in organizational, mass media, political, cultural, and international contexts. Investigates public participation in environmental advocacy and deliberation; environmental conflict management; rhetorical constructions of nature and human relationships with nature; environmental justice; environmental risk communication; and competing ecological paradigms.

Prerequisite: COM 230 or STS 214
Typically offered in Fall only

COM 441 Ethical Issues in Communication (3 credit hours)
Critical analysis of ethical problems in interpersonal and public communication practices.

Prerequisite: COM 110, 112
Typically offered in Fall and Spring

COM 442 Communication and Conflict Management (3 credit hours)
Examination of conflict styles and theories; conflict management strategies such as negotiation and third party intervention; and relevant contexts for conflict such as workplace, families, and interpersonal relationships. Practical, theoretical and critical analyses of conflict and negotiation in variety of contexts.

Prerequisite: COM 112
Typically offered in Fall only

COM 444 Film Production (3 credit hours)
Principles of cinematography, production, and editing technologies for film. Script, shoot, and edit short 16mm films. Post-production on digital non-linear editing systems. Critical analysis of production of classic and contemporary feature films.

Prerequisite:COM 267 or ENG 330
Typically offered in Fall and Spring

COM 447 Communication and Globalization (3 credit hours)
History and current trends in globalization of media, information, and telecommunications technologies, organizations, policies, and contents. Political cultural implications of globalization, including debates over corporate vs. public control of global communication, U.S. dominance vs. international cooperation, and the global influence of American culture. Internet-based group research projects on globalization in collaboration with students in other countries.

P: STS 214 or COM 257 or COM 250 or COM 200
GEP Global Knowledge
Typically offered in Summer only

COM 451 Visual Rhetoric (3 credit hours)
Examine the rhetorical strategies employed in various primarily visual forms of communication including advertising, photography, digital images, visual art, and public commemorative artifacts and sites. Explore the concepts and methods used to rhetorically analyze and interpret visual images and artifacts. Includes one or more required field trips to which students will provide own transportation.

Prerequisite: COM 201 or COM 321
Typically offered in Spring only

COM 456 Organizational Communication (3 credit hours)
Role of human communication in organizations, the assumptions inherent in management philosophies about effective communication, and an investigation of the relationships among communication, job satisfaction, productivity, development, and employeemotivation.

Prerequisite: COM 230
Typically offered in Fall and Spring

COM 457 Media and the Family (3 credit hours)
Impact of mediated messages upon children and the family unit. Origins of the empirical literature and continuing research. Assessment of the qualitative literature. Implications of commercial structure of the media industries on the structure and distribution of media messages designed for children and families. Consideration of both pro- and anti-social impacts.

P: STS 214 or COM 257 or COM 250 or COM 200
Typically offered in Fall only

COM 466 Nonprofit Leadership & Development (3 credit hours)
Nonprofit Leadership and Development is a service-learning course in which students will be expected to make a commitment to service in a local nonprofit organization for 30-hours. Students will critically examine theories of communication and leadership with concentration on issues pertaining to nonprofits such as working with executive boards, volunteer management, and resource development. Students are responsible for transportation and purchase of internship insurance.

Typically offered in Fall and Spring

COM 467 Advanced Topics in Gender and Communication (3 credit hours)
Advanced Topics seminar examining construction of gender identities through communication practices. History and analysis of gender representations. Theoretical and critical approaches to social, political, and economic impact of gender constructions.

P: COM 362 or STS 210 or COM 257 or COM 250 or COM 200
Typically offered in Fall and Spring

COM 476 Public Relations Campaigns (3 credit hours)
Management of the public relations function in organizations and public relations counseling; communication theory and nature of materials emanating from public relations departments and counseling firms, practical analysis and development of public relations publicity and campaigns.

Prerequisite: COM 226, COM 316, COM 386 and Corequisite: COM 346 (Note: COM 346 may be taken as a prerequisite or co-requisite)
Typically offered in Fall and Spring

COM 477 Mobile Communication (3 credit hours)
Mobile communication technologies and their role in communication patterns and social behavior. Conceptualization of cell phones beyond mobile telephones, as internet access points and gaming devices. History, current uses, and future perspectives for the social, cultural, and political uses of mobile interfaces. Locative media and the creation of mobile networks. Use of mobile media across cultures and places, such as Asia, Africa, and Latin America.

P: STS 214 or COM 257 or COM 250 or COM 200
Typically offered in Fall and Spring

COM 479/COM 579 Climate Change Communication (3 credit hours)
An exploration of the communication successes and failures surrounding climate change and public opinion. Topics addressed include: agenda setting, media effects, framing, data visualizations, fear responses, naming, risk communication and theory, argumentation and refutation, and persuasion as well as issues and current events related to the challenges associated with communicating climate change to multiple stakeholders.

Typically offered in Fall only

COM 484 Advanced Television Production (3 credit hours)
Television program production utilizing advanced production techniques. Emphasis on refinement of writing, producing, and directing skills through work in TV studio on production of sophisticated program formats.

P: COM 384
Typically offered in Spring only

COM 487 Internet and Society (3 credit hours)
Social uses and historic overview of the internet as a social network. History of the internet from the ARPANET to the mobile web. The development of interfaces that changed how we access the internet, such as personal computers, the graphic user interface (GUI), mobile phones, and Internet of Things. MUDs and synchronous communication environments as the origins of social media. The development of the www and web 2.0. and the transformation of users into "produsers". Social issues related to the internet, such as net neutrality, privacy, surveillance, big data, artificial intelligence, and the digital divide.

P: STS 214 or COM 257 or COM 250 or COM 200
Typically offered in Fall and Spring

COM 493 Advanced Topics in Public Relations (3 credit hours)
This course addresses current trends and recent development in the public relations profession through extensive analysis of industry practices. Course content will change each semester subject to faculty availability, but may include topics such as social media, media relations, crisis communication, international public relations, and other public relations specializations. Juniors and Seniors only.

Typically offered in Fall and Spring

COM 496 Communication Internship (3 credit hours)
Directed work experience for Communication majors with supervision from the work site and the University. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

R: Senior standing AND Communication Majors AND 12 hours in COM at 300/400-level
Typically offered in Fall, Spring, and Summer

COM 497 Advanced Topics in Media Studies (3 credit hours)
This course examines special topics in media studies through intensive study of media history, theory, research, methods and/or practice. Course content will change each semester depending on faculty areas of expertise.

Prerequisite: COM 250 or COM 257 or COM 357
Typically offered in Fall and Spring

COM 498 Advanced Topic in Communication (1-3 credit hours)
Advanced study of contemporary theories, methods, practices, processes, or issues related to the field of communication. Topic varies.

Prerequisite:Junior or senior standing
Typically offered in Fall and Spring

COM 499 Advanced Independent Research (1-3 credit hours)
Special projects in communication developed under the direction of a faculty member on a tutorial basis. Must have permission of department to enroll. May enroll only twice. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Nine credits in Communication courses. Junior standing or Senior standing in Communication
Typically offered in Fall and Spring

COM 506/ENG 506 Verbal Data Analysis (3 credit hours)
Research strategies for understanding how spoken and written language shapes activities (e.g., design, instruction, counseling, gaming interactions, e-commerce, etc.). Tracking patterned uses of language as verbal data (e.g., grammatically topically, thematically), formulating research questions, and designing studies to answer those questions through quantitative descriptive means. Sampling, collecting and managing data, developing coding schemes, achieving reliability, using descriptive statistical measures, and reporting the results.

Typically offered in Fall only

COM 508/GES 508 Emerging Technologies and Society (3 credit hours)
Provides frameworks for understanding emerging technologies and their social, political, and cultural contexts. Presents historical case studies, ethnographic accounts, and theoretical perspectives that introduce students to ways of thinking about science and technology, nature and culture, and democracy and expertise. Graduate standing is required.

Typically offered in Spring only

COM 514/ENG 514 History Of Rhetoric (3 credit hours)
Historical development of rhetorical theory with attention to contemporaneous rhetorical practice and philosophical trends. Major focus on the classical period with briefer coverage of medieval, Renaissance, 18th-century, and 19th-century developments. Implications for contemporary theory and practice, including pedagogical practice.

Typically offered in Fall only

COM 516/ENG 516 Rhetorical Criticism: Theory and Practice (3 credit hours)
Development, achievements, limitation of major critical methods in the 20th century, including neo-Aristotelian, generic, metaphoric, dramatistic, feminist, social-movement, fantasy-theme and postmodern approaches. Criticism of political discourse,institutional discourse, discourses of law, medicine, religion, education, science, the media. Relations between rhetorical and literary criticism and other forms of cultural analysis.

Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411
Typically offered in Spring only

COM 521 Communication and Globalization (3 credit hours)
Economic, political, cultural dimensions of globalization. Role of information and communication technologies, networks, institutions, and practices in human social organization.

Prerequisite: Graduate standing
Typically offered in Summer only

COM 522 Critical Approaches to Organizational Communication (3 credit hours)
Overview of critical and interpretive organizational communication research studies. Application of insights to enriching and transforming working lives.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 523 International and Intercultural Communication (3 credit hours)
Survey of intercultural, cross-cultural, and international communication theories and issues.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 525 Group/Team Communication (3 credit hours)
Comprehensive review of principles, theory, research, and practices involving group/team communication; associated with decision making, conflict management, relationship building, and evaluation of group/team effectiveness. Emphasis on guidelines for effective communication in groups and teams. Graduate standing required.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 526 Media Economics (3 credit hours)
This course provides an overview of economic perspectives on media and communication, particularly examining cases, topics, and controversies that stem from the many linkages between media and the economy. It reviews a range of perspectives on the economy of media, including the critical political economic approaches commonly employed in the field of communication, but also emerging neoclassical, behavioral, institutional, and heterodox approaches to economics, as applied to a range of possible topics. These may include: media ownership and the economics of journalism; labor and social media; data and surveillance economies; copyright and intellectual property; piracy, sharing, and collaboration; digital gift economies; social media celebrity and influencers; bitcoin and other virtual currencies; debt, credit, and algorithmic calculation; microfinance apps; "on-demand" platforms such as Uber and Lyft; automation and the future of employment; global supply chains in the manufacture of technology; the disposal of waste; consumerism and unsustainable energy use.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 527 Seminar in Organizational Conflict Management (3 credit hours)
Examination of conflict antecedents, interventions, outcomes through multiple texts, journal articles. Emphasis on workplace conflict, organizational outcomes, dispute system design. Evaluation through participation in class discussion, independent papers, research project, presentation.

Prerequisite: Graduate standing
Typically offered in Summer only

COM 528 Communication Culture and Technology (3 credit hours)
Examine Communication technology via historical examples. Inquiry into the development of early sound and screen technologies. Analysis of computer-mediated Communication genres.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 529 Communication Campaigns (3 credit hours)
Prepares students to design, implement, monitor, and evaluate a successful communication campaign for a health, public relations, or political organization that is grounded in sound theoretical approaches. The students conduct focus groups for audience research and professionally present a campaign plan to a real client for any of the mentioned types of organizations. The course emphasizes theoretical and hands on practical skills to developing successful communication campaigns.

Typically offered in Spring only

COM 530 Interpersonal Communication in Science and Technology Organizations (3 credit hours)
Blends theory and research to understand and analyze interpersonal communication practices and issues within organizations, including managing impressions and conversations, engaging in active listening, managing conflict, influencing others, and communicating in teams. Focus on developing and maintaining effective interpersonal at work and improving student's communication competence.

Prerequisite: Graduate standing
Typically offered in Summer only

COM 532 Communication Consulting (3 credit hours)
This course provides an introduction to the art and methods of consulting particularly as applied to communication problems in organizational settings. It also provides students the opportunity to develop and/or refine training and facilitation skills and to link communication theory and research to organizational practice. Graduate standing required.

Typically offered in Fall only

COM 536 Seminar in Environmental Communication (3 credit hours)
Critical analysis of environmental discourse in organizational, mass media, political, cultural, and international contexts. Investigates public participation in environmental advocacy and deliberation; environmental conflict management; rhetorical constructions of nature and human relationships with nature; environmental justice; environmental risk communication; and competing ecological paradigms. Must hold graduate standing.

P: Graduate Standing
Typically offered in Spring only

COM 537 Gaming and Social Networks (3 credit hours)
Exploration of inter-relations among mobile technologies (cell phones, PDAs), location-based activities, and playful/social spaces. Investigates: (1) the definition of basic gaming concepts (community, narrative, play, and space); (2) the history of games as social environments, with particular emphasis on multi-user domains (MUDs); and (3) the definition of games, which use the physical space as the game environment, such as pervasive games, location-based games, and hybrid reality games. Discussion of inter-connections among games, education, and art. By permission of department.

COM 538 Risk Communication (3 credit hours)
Comprehensive review of principles, theory, research, and practices involving consensus building; associated with environmental, health and safety; enabling analysis and management of risks. Emphasis on risks associated with emerging science and technology. No quantitative experience necessary. Graduate standing required.

Typically offered in Fall only

COM 539/PA 539 Fund Development (3 credit hours)
Identifies and assesses techniques and best practices of fund development, annual giving, capital campaigns, endowments. Topics include setting achievable goals, organizing and staffing a fund development campaing, and identifying donors. Discusses links between fund development and organization mission and governance, ethical issues, and government regulations. PBS status or Graduate standing.

COM 540 Critical and Interpretive Inquiry in Communication (3 credit hours)
Theoretical foundations and analytical techniques in critical and interpretive communication research. Analysis of culture and power in communicative practices, texts, technologies, production, and reception. Historical, political economic, archival, contextual, interpretive, rhetorical, and cultural modes of analysis and critique are highlighted. Graduate standing required.

Typically offered in Fall only

COM 541 Quantitative Research Methods in Applied Communication (3 credit hours)
Introduction to research methods in applied communication. Knowledge of design, implementation, and analysis of various quantitiative research methods.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 542 Qualitative Research Methods in Applied Communication (3 credit hours)
Theoretical and practical dimensions of conducting qualitative research. Issues include asking good questions, field observation, ethics, focus groups, interviews, representation of data, analyzing texts and discourse, writing qualitative reports.

Prerequisite: Graduate standing
Typically offered in Spring only

COM 543 Visual Content Analysis (3 credit hours)
Research methods class in social science-orientated quantitative or qualitative analysis. Students will advance visual research by developing and/or testing theoretical concepts for visual media. Readings will focus on analytic techniques and concepts for still or moving images in digital or traditional media. Contexts include social media, organizational websites, blogs, online news sites, films, games, mobile media, and more. Students use qualitative and quantitative analysis software. Graduate standing required

Typically offered in Fall only

COM 546 Nonprofit Marketing and Public Relations (3 credit hours)
Survey of the marketing and public relations principles and practices applicable to nonprofit organizations.

COM 547 Mobile Media and Communication (3 credit hours)
Mobile communication technologies and their influence on communication patterns and social behavior. Conceptualization of cell phones beyond mobile telephones, as Internet access points and gaming devices. History, current uses and future perspectives for the social use of mobile interfaces. The creation of new mobile communities. The influence of mobile images on communication and the creation of mobile networks. Use of mobile phones across cultures and places, such as Asia, Scandinavia, Africa, and Latin America. Permission of department.

COM 554/ENG 554 Contemporary Rhetorical Theory (3 credit hours)
Contemporary rhetorical theory covering the 20th and 21st centuries. Conceptual connections with and disruptions of the classical tradition and its, successors; relationship between rhetorical theory and philosophical trends, institutional histories, socioeconomic circumstances, and pedagogical needs. Attention to current issues such as the revival of invention, rhetorical agency, and ethics.

Typically offered in Spring only

COM 556 Seminar In Organizational Communication (3 credit hours)
Theoretic and applied approaches for studying communication perspectives of organizational behavior. Topics relate communication with organizational theories, research methods, leadership, power, attraction, conflict and theory development.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Spring only

COM 561 Human Communication Theory (3 credit hours)
The role of theory in study of human communication. General social scientific theories as well as context-based theories including interpersonal, public, group, organizational and mass communication contexts.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

COM 562 Communication and Social Change (3 credit hours)
Examine persuasive theories and methods including compliance gaining techniques. Evaluate effectiveness of public communication campaigns directed at social change.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 563 Public Relations Theory (3 credit hours)
Study the theoretical body of knowledge in public relations and its application to practice. Graduate Standing required.

Typically offered in Spring only

COM 566 Seminar In Crisis Communication (3 credit hours)
Working within theoretical perspectives of communication, conflict management and organizational designs, a theoretical understanding for crisis communication, including thorough guidelines for strategic communication planning for, managing and evaluating crises.

Typically offered in Spring only

COM 579/COM 479 Climate Change Communication (3 credit hours)
An exploration of the communication successes and failures surrounding climate change and public opinion. Topics addressed include: agenda setting, media effects, framing, data visualizations, fear responses, naming, risk communication and theory, argumentation and refutation, and persuasion as well as issues and current events related to the challenges associated with communicating climate change to multiple stakeholders.

Typically offered in Fall only

COM 581/ENG 581 Visual Rhetoric: Theory and Criticism (3 credit hours)
Application of visual theory to rhetoric and of rhetorical theory to visual forms of communication. Discussion and analysis may include advertising, photography, news and informational media, political communication, instructional material, scientific visualization, visual arts, public commemorative artifacts, internet and other digital media.

R: Graduate Students Only
Typically offered in Spring only

COM 585 Teaching College Communication (3 credit hours)
Introduction to communication education theory and research. Course divided into primary parts: 1)education theory and philosphy and 2)instructional design theory and practice.

Prerequisite: Graduate standing
Typically offered in Fall only

COM 587 Internet & Society (3 credit hours)
Overview of the development of the internet and its social uses, including the historical context that led to the development of the ARPANET and the World Wide Web. Analysis of the transition from mainframes to personal computers, to the internet of things. Treatment of principal social and communication issues related to the use of the internet, such as digital privacy, digital divide, net neutrality, and civic engagement. Development of mobile internet, social networking sites and location-based social networks.

Typically offered in Fall only

COM 598 Special Topics In Communication (1-6 credit hours)
Detailed investigation of a special topic in communication. No more than 6 hrs. may be used as credit toward graduation with master's degree.

Typically offered in Fall, Spring, and Summer

COM 630 Independent Study in Communication (1-3 credit hours)
Special projects course to be utilized for guided research at graduate level. Topic determined by instructor. No more than 6 hrs. may be used as credit toward graduation with master's degree.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

COM 650 Communication Internship (1-6 credit hours)
The internship experience provides the students the opportunity to practice professional communication skills in a workplace setting under the supervision of a communication practitioner. Restricted to MS in Communication students.

Prerequisite: Acceptance into MS in Communication Program
Typically offered in Fall, Spring, and Summer

COM 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Summer

COM 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

COM 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

COM 695 MR Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

COM 696 Summer Thesis Res (1 credit hours)
Typically offered in Summer only

COM 798 Special Topics in Communication (3-6 credit hours)
Intensive exploration of specialized or emerging topics in an area of communication theory, rhetoric, media, or other aspect of Communication studies. Emphasis on student research and writing. May be used to test and develop new courses. May be repeated for credit. Doctoral students only.

Typically offered in Fall and Spring

COM 810 Directed Readings in Communication (1-6 credit hours)
Intensive study of a specific topic from various specializations of the Communication faculty. Negotiation between the student and the director for variable credit and approved by Director of Graduate Studies. May be repeated for credit. Doctoralstudents only.

Typically offered in Fall, Spring, and Summer

COM 896 Summer Dissert Res (1 credit hours)

Communication Rhetoric & Digital Media (CRD)

CRD 701 History and Theory of Media Technologies (3 credit hours)
Foundational study of media and technology through examination of historical perspectives on technological change. Discussion of media theory, media archaeology, feminist theory, political economy, cultural studies, and functionalist perspectives on technology. Examination of media and power, social movements, alternative media, technology and development, participatory communication, technological diffusion. Research paper and seminar presentation.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 702 Rhetoric and Digital Media (3 credit hours)
Critical study and evaluation of the conceptual vocabulary of rhetoric and its relationship to digital communication and digital media.

Prerequisite: COM/ENG 514 or 516 or ENG 515, Doctoral student
Typically offered in Fall only

CRD 703 Communication Networks (3 credit hours)
Intensive study of theories, histories, and practices of networked communication. Emergence, development, acceptance, and dissolution of a variety of networks organized around information and communication technologies. Survey of network theory and methods for studying networks, networked communication practices, and their effects on issues such as identity, labor, organization, power, etc. Research/applications project developed in consultation with the instructor.

Restriction: CRDM students only
Typically offered in Spring only

CRD 704 Communication, Technologies, and Pedagogy (3 credit hours)
History, theory, research, and practice of integrating technology in higher education. Design, implementation, and critique of instructional strategies; ethical and professional issues; effects on the practices of teaching and learning and the development of communication abilities.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 790 Scholarly and Professional Paths in Disciplinary and Interdisciplinary Research (3 credit hours)
This seminar aims to 1) foster discussion about disciplinarity and interdisciplinarity, particularly in fields relevant to research in communication, rhetoric and digital media; and 2) develop and sharpen participants' theoretical and methodological positionings as they prepare to pursue their professional goals.

Prerequisite: CRD 701, 702, 703, 704, Doctoral student
Typically offered in Spring only

CRD 791 Special Topics in Communication, Rhetoric, and Digital Media (3-6 credit hours)
An intensive seminar examining a particular topic or issue in the communication and rhetoric of digital media.

Prerequisite: CRD 701
Typically offered in Fall and Spring

CRD 809 Colloquium in Communication, Rhetoric, and Digital Media (1 credit hours)
Professional development, ethical inquiry, and discussion and evaluation of interdisciplinary research in a colloquium setting. In successive fall semesters, students participate in three one-credit colloquia that include faculty and students from across the program.

Prerequisite: Doctoral student
Typically offered in Fall only

CRD 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CRD 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CRD 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Typically offered in Fall, Spring, and Summer

CRD 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CRD 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CRD 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Comparative Biological Science (CBS)

CBS 461/CBS 561 Principles of Collaboration and Team Science (2 credit hours)
The focus of this course is exploring how to effectively communicate as a member of a cross-disciplinary team. Specifically, this course offers strategies and techniques about engaging in team science to pursue complex research questions, work effectively with team members, identify and address unconscious bias, and assess team performance in order to produce high impact research outcomes. To that end, we will examine aspects of group process and communication related to professional relationship development, teamwork, leadership, and conflict resolution.

Typically offered in Spring only

CBS 463/SLC 463/CBS 563/SLC 563 Leadership in Interdisciplinary Biomedical Sciences (2 credit hours)
This is a two-credit, dual-level undergraduate/graduate course designed for graduate and advanced undergraduate students interested in gaining an understanding of how to lead others effectively through complex situations as it relates to ethical and leadership dilemmas within interdisciplinary biomedical sciences. Students will develop leadership skills and negotiation strategies for working with interdisciplinary teams in biomedicine. Through interaction with professionals in the biomedical field, students will evaluate, apply and propose action plans for how to respond to situations as it relates to theories and practices discussed in the course. This course complements, but does not replace, Responsible Conduct in Research requirements.

P: Graduate Standing
Typically offered in Fall only

CBS 493 Undergraduate Research in Biomedical Sciences (1-3 credit hours)
A learning experience in College of Veterinary Medicine within an academic framework that utilizes campus facilities and resources for supervised undergraduate research. Arrangements must be initiated by the student and be approved by a faculty adviser, the college Undergraduate Research Coordinator, and the Associate Dean of Research Training and Graduate Programs. Students who enroll in this course are required in this course to complete and submit an Agreement for Non-Standard Courses form through Registration and Records.

Requisite: Sophomore Standing or Above
Typically offered in Fall and Spring

CBS 510 Animal Production Topics (1-3 credit hours)
Students will be provided with experience in management of production animals with an emphasis on the veterinary aspects of population health. Experience will come in the form of hands-on experiences and working through relevant literature to specific and relevant population health issues.

Typically offered in Fall and Spring

CBS 550 Population Medicine Forum (1 credit hours)
Population medicine forum is a seminar-based class during which current topics in population health are presented and discussed. Topics covered include: Outbreak investigation, observational epidemiologic research, risk analysis, spatial analysis, the application of unique diagnostic technologies and epidemiologic modeling.

Typically offered in Fall and Spring

CBS 561/CBS 461 Principles of Collaboration and Team Science (2 credit hours)
The focus of this course is exploring how to effectively communicate as a member of a cross-disciplinary team. Specifically, this course offers strategies and techniques about engaging in team science to pursue complex research questions, work effectively with team members, identify and address unconscious bias, and assess team performance in order to produce high impact research outcomes. To that end, we will examine aspects of group process and communication related to professional relationship development, teamwork, leadership, and conflict resolution.

Typically offered in Spring only

CBS 563/SLC 563/CBS 463/SLC 463 Leadership in Interdisciplinary Biomedical Sciences (2 credit hours)
This is a two-credit, dual-level undergraduate/graduate course designed for graduate and advanced undergraduate students interested in gaining an understanding of how to lead others effectively through complex situations as it relates to ethical and leadership dilemmas within interdisciplinary biomedical sciences. Students will develop leadership skills and negotiation strategies for working with interdisciplinary teams in biomedicine. Through interaction with professionals in the biomedical field, students will evaluate, apply and propose action plans for how to respond to situations as it relates to theories and practices discussed in the course. This course complements, but does not replace, Responsible Conduct in Research requirements.

P: Graduate Standing
Typically offered in Fall only

CBS 565 Fundamentals of Biomedical Sciences (3 credit hours)
Introductory course for students interested in gaining a broad understanding of: comparative genomics, comparative immunology, comparative physiology, pharmacokinetics, emerging zoonotic diseases, epidemiology and translational research models and methods. This course also provides an overview of current technologies relevant to comparative biomedical research and a foundation for implementing the scientific method (e.g. experimental design, data analyses, statistics). Priority will be given tofirst-year students in CBS graduate program; Enrollment of all students requires consent of instructor.

Typically offered in Fall only

CBS 570 Methods in Biomedical Sciences (1 credit hours)
Introductory course for students interested in gaining a broad understanding of various laboratory methods used in molecular, cellular and "omics" based biomedical research.

Typically offered in Fall only

CBS 579 Advanced Specialty Training (1-3 credit hours)
This course is designed to give students clinical experience and training to understand basic health management strategies, handle clinical evaluations, use diagnostic tools to facilitate accurate diagnosis, and develop prevention and/or treatment plans for health management. This course is restricted to Students in the SVM program.

Typically offered in Fall and Spring

CBS 580 Clinical Veterinary Epidemiology (3 credit hours)
To expose students to the concepts and principles of epidemiology from the perspective of assessing health and disease in animal and human populations, and the measures to control disease status. Specifically to study the principles and concepts ofveterinary epidemiology, to learn basic epidemiology methodology, critically review major veterinary care studies, and enhance oral and written communication skills.

Prerequisite: ST 511
Typically offered in Fall only

CBS 586 One Health: From Philosophy to Practice (2 credit hours)
Graduate/professional seminar (with team project) addressing intersections of veterinary medicine, human medicine, and environmental health. Co-listed at UNC CH Gillings School of Global Public Health and Duke University School of Medicine. Includes participants from these three institutions, plus related private-sector members, non-governmental organizations, and government professionals. Its purpose is to facilitate understanding of one health as a system of systems, and promote cross-campus and cross-discipline interactions. Weekly evening course held at NC Biotechnology Center, RTP. Requires graduate student standing at NCSU or professional student standing within the College of Veterinary Medicine. Limit: 15 students per university.

Typically offered in Fall only

CBS 595 Special Topics (1-6 credit hours)

CBS 615 Advanced Animal Production Topics (1-3 credit hours)
Students will be provided with practice and experience in advanced topics related to management of production animals with an emphasis on the veterinary aspects of population health. Actual in-the-field, hands-on practice and investigation of relevant literature will provide the basis for study of advanced animal production topics. Course is restricted to students in the SVM program

Prerequisite: SVM 510
Typically offered in Fall and Spring

CBS 624 Special Problems In Gastrointestinal Physiology (1 credit hours)
1 credit for a 1-hour in depth discussion session of current journal articles presented by students on the subject of gastrointestinal physiology. Journals recommended include the American Journal of Physiology, Gut and Gastroenterology. Each session will focus on one student's selected paper. MS students are expected to present 1 paper, and PhD students are expected to present up to 2 papers each semester. Students should be enrolled in a graduate course of study in a field related to or focused on physiology. Undergraduate students require special permission.

Typically offered in Fall and Spring

CBS 649 Issues in Preventive Medicine and Public Health (1 credit hours)
Issues in Preventive Medicine and Public Health is a literature review course designed to assist students with their preparation for careers in public health, ecosystem health, biosecurity and public policy, disaster management, and application for Board Certification in the American College of Preventive Veterinary Medicine. Permission by course instructor required for enrollment.

Prerequisite: A prior degree in veterinary medicine or public health

CBS 650 Population Medicine Forum (1 credit hours)
Population medicine forum is a seminar-based class during which current topics in population health are presented and discussed. Topics covered include: Outbreak investigation, observational epidemiologic research, risk analysis, spatial analysis, the application of unique diagnostic technologies and epidemiologic modeling.

Typically offered in Fall and Spring

CBS 660 Fundamentals of Comparative Molecular Medicine (3 credit hours)
This is a 3 credit, graduate level course designed for incoming graduate students and advanced undergraduate students interested in gaining a broad understanding of: translational/clinical research, interdisciplinary research related to molecular medicine, basic principles of genetics, cell biology and engineering and how they are applied to the study/treatment of disease. The importance of large animal models to facilitate clinical translation to humans will also be covered. Course instructors include both basics scientists with active research programs as well as clinicians (MD and DVM).

Prerequisite: Graduate Standing or Background in Biology at the Advanced Undergraduate Level
Typically offered in Fall only

CBS 662 Professional Conduct in Biomedical Research (1 credit hours)
Plagiarism, authorship, fraud, safety, sexual harassment, IACUC, consulting agreements, serving as an expert witness, contacting elected officials, working with press, human subjects committee, and related topics.

Typically offered in Spring only

CBS 680 MR Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

CBS 682 Seminar - Poultry Medicine (1-3 credit hours)
Typically offered in Fall only

CBS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 686 Food Animal Health Teachings (1-3 credit hours)

CBS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 695 Master's Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CBS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CBS 705/BIO 705 Fundamentals of Neuroscience (3 credit hours)
This is a fundamental course that will provide the student with an up-to-date coverage of molecular, cellular, physiological, and circuit-based aspects of Modern Neurosciences in the Comparative Biomedical Sciences Graduate Program. Being a graduate-level class, the instructors will assume that the students have acquired some background in basic biology and biochemistry. The most important goal of this course is to train PhD students in neuroscience function and disorders, preparing them for neuroscience research. Emphasis will be placed on the systems and skills needed to pursue experimental neuroscience activities. Important components of the learning process will be presentations from neuroscience experts, class discussions, exams and in class activities.

P: BIO 488 or permission of instructor
Typically offered in Fall only

CBS 711 Applications in Reproductive Physiology (2 credit hours)
Students with advanced interests in Theriogenology will meet weekly to discuss a wide range of current topics surrounding animal reproduction, including comparative physiology and endocrinology, reproductive management, reproductive pharmacologic/technologic advances in Theriogenology. Each student will be expected to present 2-3 topics with typed, referenced notes and an oral presentation. All students will be expected to actively participate in group discussions and briefly present a review of one topic-related article from the past 5 years during each lecture.

Typically offered in Fall only

CBS 712 Reproductive Management and Disease in Domestic Animals (1 credit hours)
Students will meet every other week to review current literature and discuss a wide range of topics surrounding animal reproduction, focused on clinical causes of infertility and their treatments in domestic and non-domestic species. Students will explore 3-5 preassigned questions surrounding a particular topic and prepare an in-depth handout answering those questions prior to arrival. Each student will be expected to actively participate in group discussions

Typically offered in Fall and Spring

CBS 733 Pharmacology I (2 credit hours)
This course focuses on the action of drugs in animals and basic principles of drug disposition and pharmacokinetics. The course will provide presentations on the principles of pharmacology of medications used in animals. Principles of autonomic pharmacology will form a foundation that is important to other drug groups. Important drug groups discussed during the course will be sympathetic and parasympathetic agonists and antagonists, anesthetic, sedative, and tranquilizer drugs. During the chemotherapy portion of the course, anti-infective agent chemotherapy will be discussed, which includes antibacterial, antiparasitic, antifungal, and antiviral drugs. Anticancer agents also will be considered in the chemotherapy portion of the course.

Typically offered in Fall only

CBS 734 Pharmacology II (2 credit hours)
This is a course in veterinary pharmacology. This course focuses on the action of drugs in animals and basic principles of drug disposition and pharmacokinetics. The course will provide presentations on the principles of pharmacology of medications used in animals. Important drug groups discussed during the course will be anti-infective agents used in chemotherapy. These include antibacterial drugs, antifungal drugs, antiviral drugs, and antiparasitic drugs. Anticancer drugs also will be included. Also included in the course are drugs that affect specific body systems such as ophthalmology, gastrointestinal, cardiovascular, and kidneys.

Bachelors Degree in Biological
Typically offered in Spring only

CBS 750 Techniques in Pharmacological Research (2 credit hours)
Theory and applications of modern scientific instrumentation to analysis of tissues, body fluids and drugs in pharmacological research. Discussion of appropriate aspects of the pharmacological use of spectroscopy, microscopy, chromatography, electrophoresis, radioisotope usage and centrifugation.

Prerequisite: BCH 452B or CH 315 or Equivalent and Graduate standing
Typically offered in Spring only

CBS 754 Epidemiology II (3 credit hours)
Study design, data management, and statistical analysis including applications of logistic regression and survival analysis. Main focus on descriptive, analytical and experimental epidemiology pertinent to disease etiology and prevention.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CBS 762 Principles of Pharmacology (3 credit hours)
The action of drugs in animals and man including basic principles of drug disposition, pharmacokinetics, drug resistance, and signal transduction. Modification of physiological processes by drugs influencing nervous, renal, cardiovascular, and endocrine systems and the antimicrobic and antineoplastics agents.

Typically offered in Spring only

CBS 764/NTR 764/PHY 764 Advances in Gastrointestinal Pathophysiology (3 credit hours)
This course will focus on advanced gastrointestinal physiology and the pathophysiology of deseases of relevance to scientsts involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature rgarding a specific gastrointestinal disease.

Prerequisite: PHY 503, PHY 504
Typically offered in Fall only

CBS 770 Cell Biology (3 credit hours)
Advanced cell and organelle structure and function and recent advances in molecular biology. Emphasis on current literature and application of research procedures.

Prerequisite: BCH 451 and BIO 183 and (CH 223 or CH 227)
Typically offered in Spring only

CBS 771/TOX 771 Cancer Biology (4 credit hours)
A comprehensive graduate course focusing on the molecular and cellular bases of cancer. Targets of oncogenic mutations will be discussed as well as their impact on cell proliferation, cell survival, and the invasion of normal tissues by tumorigeniccells. State-of-the-art technologies to detect oncogenic mutations and characterize transformed cells will be discussed as well as therapeutic strategies for the rational treatment of cancer.

Prerequisite: CBS 770
Typically offered in Fall only

CBS 775 Designing population-based research (3 credit hours)
The objective of this course is to introduce graduate students to the design of contemporary population-based research, defined broadly as research involving populations including epidemiological, clinical, and outcomes-based studies. Students will be introduced to basic concepts necessary to design and conduct population-based research, as well as, emergent technologies and concepts in the field of population health. Students will gain practice by creating a protocol for a research study addressing a relevant research question in their specific area of interest.

Prerequisite: ST 511
Typically offered in Spring only

CBS 783/IMM 783/MB 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only

CBS 787 Pharmacokinetics (3 credit hours)
Mathematical models to describe disposition of drugs and toxic chemicals in the animal body. Areas including classic compartmental and nonlinear models as well as physiological approaches. Discussion of application of these techniques to toxicologicstudies.

Prerequisite: CBS 560, working knowledge of calculus
Typically offered in Fall only

CBS 795 Special Topics in Comparative Biomedical Sciences (1-6 credit hours)
Special Topics in Comparative Biomedical Sciences

Prerequisite: Graduate Students, DVM or equivalent degree

CBS 800 CBS Seminar (1 credit hours)
Presentation and discussions on ongoing research and current topics in biomedical sciences.

Typically offered in Fall only

CBS 803 Seminar in Surgical Pathology (1 credit hours)
Description and interpretation of microscopic changes in tissues from diseased domestic and laboratory animals. Students attend and participate in a one-hour weekly seminar where microscopic lesions described, interpreted and discussed.

Prerequisite: Those holding the DVM or equivalent degree
Typically offered in Spring only

CBS 804 Seminar in Necropsy Pathology (1 credit hours)
Description and interpretation of gross changes in tissues from diseased domestic animals. Students attend daily (M-F) 15-to 30-minute review of necropsy lesions presented by a member of the graduate staff.

Prerequisite: Those holding the DVM or equivalent degree
Typically offered in Spring only

CBS 805/BIO 805 Special Topics in Neuroscience (1 credit hours)
Topics in neuroscience. This course will provide an opportunity for students to integrate and apply knowledge and skills gained from their graduate studies. Emphasis will be placed on primary literature, scientific practice, and on effective, professional communication and presentations. Topics and instructors will vary from semester to semester. Priority will initially be given to graduate students participating in the neuroscience concentration; other students with the necessary prerequisites will be admitted on a space available basis.

R: Grad Standing or Instructor Approval
Typically offered in Spring only

CBS 806 Animal Models in Comparative and Translational Research (2 credit hours)
This course provides an overview of several models of comparative and translational research including the discussion of naturally occurring vs experimental models of disease. We will review 12 animal models and use them as examples to discuss the challenges faced during model development, relevance of the selected models to other animal species and humans, and the advantages/disadvantages of each animal model.

R: Comparative Biomedical Sciences students with an interest in translational animal models.
Typically offered in Spring only

CBS 810 Special Topics (1-6 credit hours)
Designed to present new or special subject matter within the scope of pathology, veterinary microbiology, morphology or pharmacology. The studies may include independent investigations, seminars and/or formal lectures.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

CBS 816 Advanced Topics In Immunology (1 credit hours)
Selected topics of current interest in immunology. A different topic will be covered each semester to focus on the most recent developments in the field.

Typically offered in Fall and Spring

CBS 817 Advanced Topics In Zoological Medicine I (2 credit hours)
Selected topics of current interest in clinical zoological medicine focused on marine mammals, fish, reptiles, amphibians, waterfowl, ratites, raptors and medical issues in free-ranging wildlife. Review of current clinical and basic science literature, student-lead discussion sessions and participation in faculty-lead discussions.

Prerequisite: Graduate standing or enrollment in DVM curriculum
Typically offered in Fall only

CBS 818 Advanced Topics in Zoological Medicine (2 credit hours)
This course provides breadth and depth of knowledge in zoological medicine to prepare Zoological Medicine residents to pass American College of Zoological Medicine (ACZM) boards. Veterinary students are exposed to more in depth information related to zoological medicine than covered in their core curriculum. Each Fall (CBS 817) and Spring (CBS 818) semesters, different aspects of zoological medicine are covered. Topics rotate every 3 years so that all major groups of animals within the sub-groups, avian, aquatic, herptile, wildlife, and zoo are addressed.

Prerequisite: Graduate standing or enrollment in DVM curriculum
Typically offered in Spring only

CBS 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in CBS.

Typically offered in Fall and Spring

CBS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CBS 886 Interdisciplinary Research Team Mentoring (3 credit hours)
This course will be a guided teaching experience within an academic framework that utilizes campus facilities and resources for supervised research. This course requires that you develop a research project with another graduate student and/or postdoctoral fellow and that, once approved, that an undergraduate student is added to the research team. This team then works together to complete the project. In addition, the teams will meet with course directors to ensure that the mentoring and research experience meets the course requirements The course includes hands-on mentoring in a laboratory setting, as well as participation in group meetings to develop skills associated with organizing and presenting research results both in written and verbal format.

This course is related to the CMI Young Scholars Program that requires a graduate students to mentor an undergraduate in a pre-approved research project. https://research.ncsu.edu/cmi/young-scholars-program/
Typically offered in Fall, Spring, and Summer

CBS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CBS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CBS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Comparative Literature (CL)

CL 495 Special Topics in Comparative Literature (3 credit hours)
Detailed investigation of a topic in comparative literature. Topic and mode of study determined by faculty member(s) in consultation with Comparative Literature Committee and heads of departments of English and Foreign Languages.

Computer Science (CSC)

CSC 110 Computer Science Principles - The Beauty and Joy of Computing (3 credit hours)
This course explores the principles of computer science while emphasizing the relevance of computing to students and to society. Students will learn about beautiful computing applications that have changed the world and how computing empowers discovery and innovation. Students will learn the joy of programming a computer using a friendly, graphical language, capable of creating apps, simulations, and games. Students who complete the course will be able to solve meaningful problems with computers, apply design processes to take an idea from concept to implementation, develop a computer program, and analyze computing artifacts from both design and computing perspectives. Students will complete a substantial team programming project related to their interests. 20% of seats will be restricted to Computer Science or CS-Intended students. Enrolling students must not have received credit for or a grade in CSC 116 or CSC 200.

Restriction: Cannot have taken CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or CSC 200
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

CSC 111 Introduction to Computing: Python (3 credit hours)
Computation problem solving through writing Python programs. Particular elements include: careful development of Python programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications. Most seats reserved for Civil, Construction, and Environmental Engineering majors.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141
Typically offered in Fall and Spring

CSC 112 Introduction to Computing-FORTRAN (3 credit hours)
Problem solving through writing FORTRAN programs. Particular elements include: careful development of FORTRAN programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141
Typically offered in Fall, Spring, and Summer

CSC 113 Introduction to Computing - MATLAB (3 credit hours)
Problem solving through writing MATLAB programs. Particular elements include: careful development of MATLAB programs from specifications; documentation and style; appropriate use of control structures, data types and subprograms; abstractions and verification; engineering applications. Most seats reserved for Aerospace, Mechanical, and Biomedical Engineering majors.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141
Typically offered in Fall and Spring

CSC 116 Introduction to Computing - Java (3 credit hours)
An introductory course in computing in Java. Emphasis on algorithm development and problem solving. Careful and methodical development of Java applications from specifications; documentation and style; appropriate use of control structures; classes and methods; data types and data abstraction; object-oriented programming and design; software testing. Most seats reserved for Computer Science majors.

Co-requisite: E 115 or COS 100 and MA 121 or MA 131 or MA 141
Typically offered in Fall, Spring, and Summer

CSC 216 Software Development Fundamentals (3 credit hours)
The second course in computing, intended for majors and minors. Emphasis is on exploring encapsulation; polymorphism; composition; inheritance; finite state machines; linear data structures (including array lists, linked lists, stacks, queues, and the tradeoffs in implementation); and recursion (including recursive linked lists) in the context of the software development lifecycle including the processes and practices for designing, implementing, and testing high quality software.

Prerequisite: CSC 116 with a grade of C or better; Corequisite: CSC 217
Typically offered in Fall, Spring, and Summer

CSC 217 Software Development Fundamentals Lab (1 credit hours)
Laboratory course to accompany CSC 216 lecture course. Application of the software processes and practices to design, implement, and test the development of software solutions requiring composition; inheritance; finite state machines; and linear data structures, including recursive linked lists.

Prerequisite: CSC 116 with a C or better; Corequisites: CSC 216
Typically offered in Fall, Spring, and Summer

CSC 226 Discrete Mathematics for Computer Scientists (3 credit hours)
Propositional logic and predicate calculus. Logic gates and circuits. Methods of proof. Mathematical induction. Recursive definitions and functions. Solving recurrences. Asymptotic growth of functions. Elementary combinatorics and probability. Introduction to graph theory. Binary relations, including posets and equivalence relations. This course assumes knowledge of topics covered in high-school Algebra I and II. Most seats reserved for CSC and CPE majors and Computer Programming minors.

Typically offered in Fall, Spring, and Summer

CSC 230 C and Software Tools (3 credit hours)
In this course, students will develop skills in several important areas. First, we'll get some experience working in C, a language that lets us think like procedural rather than object-oriented developers. Also, being a fairly low-level language, C lets us see and control more of what's going on in the hardware. This can help us think about using the hardware more effectively, whether we're actually programming in C or in a higher-level language. While we learn C, we'll also learn about tools and techniques that help us build, manage, debug and analyze software projects.

Prerequisite: CSC 216 with a C or better.
Typically offered in Fall, Spring, and Summer

CSC 236 Computer Organization and Assembly Language for Computer Scientists (3 credit hours)
Computer architecture topics required by professional software developers, including binary and hexadecimal numbers, hardware component organization, machine instruction sets, assembler language programming, linking assembler language with high-level languages, program testing, computer hardware design issues, computer software design issues, and trends in current computer design.

Prerequisite: CSC 230 or ECE 209
Typically offered in Fall, Spring, and Summer

CSC 246 Concepts and Facilities of Operating Systems for Computer Scientists (3 credit hours)
This course prepares students to understand fundamental issues in operating systems. Students will be introduced to multi-threading, synchronization, scheduling, virtual memory, security and communication/networking. The material will be covered in terms of operating systems services exported by the operating systems interface. Current trends will be discussed to give a better understanding of future developments likely to be included in operating systems.

Prerequisite: CSC 230 or ECE 209
Typically offered in Fall, Spring, and Summer

CSC 251 Web Page Development (1 credit hours)
Syntax and semantics of HTML (HyperText Markup Language). Students will learn necessary skills to develop web pages on their EOS/Unity account. In addition to mechanics, design aspects and bandwidth conservancy are covered. Several pages will be created including a final project.

Prerequisite: E 115 or equivalent knowledge of EOS/Unity system
Typically offered in Spring only

CSC 255 String Processing Languages (1 credit hours)
Syntax and semantics of a string manipulation language, currently SNOBOL 4. Application of the language to programming problems in non-numeric areas. Discussion of other string processing languages such as PERL.

Prerequisite: Programming knowledge
Typically offered in Fall only

CSC 281 Foundations of Interactive Game Design (3 credit hours)
Surveys history, technology, narrative, ethics, and design of interactive computer games. Work in teams to develop novel game designs and computer games. Introduction to the interplay of narrative, technology, rule systems, play and culture in the creation of interactive games. Programming experience not required. Enrollment restricted to students with at least sophomore status.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

CSC 295 Special Topics in Computer Science (1-3 credit hours)
Special topics in CSC at the early undergraduate level.

CSC 297 Cybersecurity Topics (1 credit hours)
Introductory cybersecurity topics that may cover areas like cybersecurity policy, law, attacks and defenses, ethics, forensics, social engineering, usability, or privacy. Topics will vary by section and semester. Course may be taken multiple times only if topic is different.

Typically offered in Fall and Spring

CSC 298 Introduction to Computer Science Research Methods (3 credit hours)
Introduction to computer science research methods for first or second year Computer Science undergraduate students. Topics include creating research problems, reading research papers, conducting a literature review, designing research studies, qualitative and quantitative data analysis, communication of research findings, teamwork, and research directions. Students will work on teams to complete a mentored research proposal.

Typically offered in Fall only

CSC 299 Mentored Research in Computer Science (1-3 credit hours)
Mentored research experience in Computer Science. The experience must be arranged in advance by the student and approved by the Department of Computer Science prior to enrollment. A minimum of 45 hours must be completed for each credit hour earned. A final report approved by the faculty mentor and the department are required. Individualized/Independent Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" to be completed by the student and faculty member prior to registration by the department. CSC 299 may not be repeated.

Typically offered in Spring only

CSC 302 Introduction to Numerical Methods (3 credit hours)
Numerical computations with digital computers; floating point arithmetic and implications of round-off error; Monte Carlo methods. Algorithms and computer techniques for the numerical solution of problems in: function evaluation; zeros of functions; interpolation; numerical differentiation and integration; linear systems of equations; curve fitting; solutions of non-linear equations; optimization.

Prerequisite: CSC 116 with a grade of C or higher and MA 305 or MA 405
Typically offered in Fall only

CSC 316 Data Structures and Algorithms (3 credit hours)
Abstract data types; abstract and implementation-level views of data types. Linear and branching data structures, including stacks, queues, trees, heaps, hash tables, graphs, and others at discretion of instructor. Best, worst, and average case asymptotic time and space complexity as a means of formal analysis of iterative and recursive algorithms.

Prerequisite: CSC 216 with a grade of C or better and (CSC 226 or MA 225) with a grade of C or better
Typically offered in Fall, Spring, and Summer

CSC 326 Software Engineering (4 credit hours)
Application of software engineering methods to develop complex products, including the following skills: quality assurance, project management, requirements analysis, specifications, design, development, testing, production, maintenance, security, privacy, configuration management, build systems, communication, and teaming.

Prerequisite: [CSC 230 or ECE 209] and [CSC 316 or ECE 309]
Typically offered in Fall and Spring

CSC 333 Automata, Grammars, and Computability (3 credit hours)
Study of three classical formal models of computation--finite state machines, context-free grammars, and Turing machines--and the corresponding families of formal languages. Power and limitations of each model. Parsing. Non-determinism. The Halting Problem and undecidability. The classes P and NP, and NP-completeness.

Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Fall and Spring

CSC 342 Applied Web-based Client-Server Computing (3 credit hours)
This course explores client-server computing on the World Wide Web. The course focuses on the architecture of web-based client-server applications and accepted industry practices. Students work in teams to develop web applications with dynamic content delivery.

Prerequisite: Grade of C or better in CSC 216

CSC 379 Ethics in Computing (1 credit hours)
Computers have become ubiquitous and advances in computing power and accessibility have enabled applications that were speculation a generation ago. Computing professionals, as the gatekeepers of this technology, have significant responsibilities to society. This course examines the role of the computing professional in modern society, focusing on the ethical and moral responsibilities of the profession. Additional topics will include moral/ethical decision-making, whistle-blowing, global organizations, licensure, and emerging technologies.

Requirement: Junior Standing
Typically offered in Fall and Spring

CSC 401 Data and Computer Communications Networks (3 credit hours)
This course provides an introduction to fundamental concepts in the design and implementation of computer networks, their protocols, and applications with a particular emphasis on the Internet's TCP/IP, OSPF/BGP, Ethernet, IEEE 802.11 protocol suite. Topics to be covered include: network architectures, packet/circuit switching, network applications, sockets, reliable data transport, flow control, congestion control, routing, link protocols, addressing, local area networks, wireless networks, mobility, management, network security, software defined networking and the design of network services. Credit is not allowed for both CSC 401 and ECE 407.

Prerequisite: ST 370 and CSC 246
Typically offered in Fall, Spring, and Summer

CSC 402 Networking Projects (3 credit hours)
Through a series of hands-on networking labs, students will gain experience in practical topics such as network configuration, troubleshooting, and static and dynamic routing. The course prepares students sufficiently for an industry certification.

Prerequisite: CSC 401
Typically offered in Spring only

CSC 405 Computer Security (3 credit hours)
Basic concepts and techniques in information security and management such as risks and vulnerabilities, applied cryptography, program security, malicious software, authentication, access control, operating systems security, multilevel security, trusted operating systems, database security, inference control, physical security, and system assurance and evaluation. Coverage of high-level concepts such as confidentiality, integrity, and availability applied to hardware, software, and data.

Corequisite: CSC 246
Typically offered in Spring only

CSC 406/CSC 506/ECE 506/ECE 406 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall and Spring

CSC 411 Introduction to Artificial Intelligence (3 credit hours)
Overview and definitions of Artificial Intelligence (AI). Search, including depth-first and breadth-first techniques with backtracking. Knowledge representation with emphasis on logical methods, Horn databases, resolution, quantification, unification, skolemization and control issues; non-monotonic reasoning; frames; semantic nets. AI systems, including planning, learning, natural language and expert systems. An AI programming language may be taught at the instructor's discretion.

Prerequisite: CSC 316 or ECE 309
Typically offered in Spring only

CSC 412/CSC 512 Compiler Construction (3 credit hours)
The course will concentrate on the theory and practice of compiler-writing. Topics to be covered will include techniques for parsing, code generation, and optimization. Furthermore, the theoretical underpinnings of compilers such as LR parsing will be covered. Finally, the students will be exposed to compiler construction tools, and will obtain hands-on experience in building a compiler for a small programming language. Besides the listed prerequisite courses, other helpful courses include CSC 253, CSC 224, CSC 234, and MA 121.

Prerequisites: Graduate standing and CSC 316 and CSC 333 or equivalent classes.
Typically offered in Fall only

CSC 414/CSC 514/MA 414/MA 514 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property.
You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.

Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

CSC 415 Software Security (3 credit hours)
Introduces students to the discipline of designing, developing, and testing secure and dependable software-based systems. Students will learn about risks and vulnerabilities, and effective software security techniques. Topics include common vulnerabilities, access control, information leakage, logging, usability, risk analysis, testing, design principles, security policies, and privacy. Project required.

Corequisite: CSC 326
Typically offered in Fall only

CSC 416/MA 416 Introduction to Combinatorics (3 credit hours)
Basic principles of counting: addition and multiplication principles, generating functions, recursive methods, inclusion-exclusion, pigeonhole principle; basic concepts of graph theory: graphs, digraphs, connectedness, trees; additional topics from:Polya theory of counting, Ramsey theory; combinatorial optimization - matching and covering, minimum spanning trees, minimum distance, maximum flow; sieves; mobius inversion; partitions; Gaussian numbers and q-analogues; bijections and involutions; partially ordered sets.

Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Spring only

CSC 417 Theory of Programming Languages (3 credit hours)
Theory of programming languages with emphasis on programming language semantics and implementation issues. Formal models of syntax and semantics. Static versus dynamic scoping. Parameter passing mechanisms. Garbage collection. Programming in alternate paradigms such as applicative, functional, logic, and object-oriented programming languages.

Prerequisite: CSC 316 or ECE 309
Typically offered in Fall and Spring

CSC 422/CSC 522 Automated Learning and Data Analysis (3 credit hours)
This course provides an introduction to concepts and methods for extracting knowledge or other useful forms of information from data. This activity, also known under names including data mining, knowledge discovery, and exploratory data analysis, plays an important role in modern science, engineering, medicine, business, and government. Students will apply supervised and unsupervised automated learning methods to extract patterns, make predictions and identify groups from data. Students will also learn about the overall process of data collection and analysis that provides the setting for knowledge discovery, and concomitant issues of privacy and security. Examples and projects introduce the students to application areas including electronic commerce, information security, biology, and medicine. Students cannot get credit for both CSC 422 and CSC 522.

Prerequisite: CSC 226 or LOG 201, ST 370, MA 305 or MA 405
Typically offered in Fall and Spring

CSC 427/MA 427 Introduction to Numerical Analysis I (3 credit hours)
Theory and practice of computational procedures including approximation of functions by interpolating polynomials, numerical differentiation and integration, and solution of ordinary differential equations including both initial value and boundary value problems. Computer applications and techniques.

Prerequisite: (MA 341 or MA 301) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Fall only

CSC 428/MA 428 Introduction to Numerical Analysis II (3 credit hours)
Computational procedures including direct and iterative solution of linear and nonlinear equations, matrices and eigenvalue calculations, function approximation by least squares, smoothing functions, and minimax approximations.

Prerequisite: (MA 305 or MA 405) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Spring only

CSC 431 File Organization and Processing (3 credit hours)
Hardware characteristics of storage devices. Basic file organizations including sequential, direct, and indexed sequential; hashing and collision resolution; perfect hashing; signatures; bloom filters; sorting and other bit level structures. Tree structures including binary search trees, B-trees, and trees. Dynamic hashing techniques. Structures including grid files. Applying file structures to practical problems.

Prerequisite: CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Fall and Spring

CSC 433 Privacy in the Digital Age (3 credit hours)
Privacy is a growing concern in our modern society. We interact and share our personal information with a wide variety of organizations, including financial and healthcare institutions, web service providers and social networks. Many times such personal information is inappropriately collected, used or shared, often without our awareness. This course introduces privacy in a broad sense, with the aim of providing students an overview of the challenging and emerging research topics in privacy. This course will expose students to many of the issues that privacy engineers, program managers, researchers and designers deal with in industry. ST 370 is recommended.

P: CSC 316
Typically offered in Spring only

CSC 440 Database Management Systems (3 credit hours)
Introduction to database concepts. This course examines the logical organization of databases: the entity-relationship model; the relational data model and its languages. Functional dependencies and normal forms. Design, implementation, and optimization of query languages; security and integrity, concurrency control, transaction processing, and distributed database systems.

Prerequisite: CSC 316 or ECE 309
Typically offered in Fall only

CSC 442/ST 442 Introduction to Data Science (3 credit hours)
Overview of data structures, data lifecycle, statistical inference. Data management, queries, data cleaning, data wrangling. Classification and prediction methods to include linear regression, logistic regression, k-nearest neighbors, classification and regression trees. Association analysis. Clustering methods. Emphasis on analyzing data, use and development of software tools, and comparing methods.

Prerequisite: (MA 305 or MA 405) and (ST 305 or ST 312 or ST 370 or ST 372 or ST 380) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or ST 114 or ST 445)
Typically offered in Fall only

CSC 447 Introduction to Cloud Computing (3 credit hours)
The course will provide an introduction and overview to cloud computing principles and architectures at the undergraduate level. The course will start by reviewing the history of centralized and distributed computing and trace how developments over the years have resulted in today's current cloud computing technology. The course will provide an in-depth overview of cloud types and services, virtualization, cloud architectures for both private and public cloud offerings, computer networking topics of relevance to cloud computing, cloud computing security and both the economic and legal aspects of cloud computing systems along with advanced topics such as cloud storage and cloud hosted databases. The course will also include hands-on installation and operation of the NC State VCL private cloud computing system on a dedicated compute node assigned to each student and an individual account on the Amazon AWS public cloud service for gaining practical experience with cloud computing instances.

Prerequisite: CSC 246
Typically offered in Fall only

CSC 450 Web Services (3 credit hours)
Concepts, theories, and techniques for Web services. This course examines architectures for Web applications based on the classical publish, find, and bind triangle. It considers the description, discovery, and engagement of Web services. It emphasizes Web service composition. Key topics include semantics, transactions, processes, agents, quality of service, and compliance.

Prerequisite: CSC 316 or ECE 309
Typically offered in Fall only

CSC 453 Introduction to Internet of Things (IoT) Systems (3 credit hours)
CSC 453: Introduction to Internet of Things (IoT) Systems is a senior-level CSC restricted undergraduate elective on the concepts, protocols, techniques and design methodology underlying current and emerging networked wireless sensor/actuator systems coming to be known as IoT systems, at the intersection of physical computing, semantics and analytics, wireless communications, and networked distributed systems. Design considerations of such systems include diverse metrics such as delay, stability, privacy, expandability. The course includes (i) descriptive material on basic concepts and techniques appropriate to sensor networks, and analytics and semantics concepts appropriate to IoT systems, and (ii) hands-on work with a sampling of representative sensors and actuators, small format computers, networked application programming, and validation in real physical environments. The course includes a term project with assigned teams and project areas to design and implement a complete small IoT system. Students will be expected to purchase equipment for the course, costing about $70-$130.

Prerequisite: CSC 246 or ECE 306 and CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Spring only

CSC 454 Human-Computer Interaction (3 credit hours)
A survey of concepts and techniques for user interface design and human computer interaction. Emphasizes user-centered design, interface development techniques, and usability evaluation.

Prerequisite: CSC 316 or ECE 309
Typically offered in Spring only

CSC 455 Social Computing and Decentralized Artificial Intelligence (3 credit hours)
This course surveys the field of social computing, introducing its key concepts, paradigms, and techniques. Specific topics are selected from the following list: social media and social network analytics, sociological underpinnings, crowdsourcing and surveys, human computation, social mobilization, human decision making, voting theory, judgment aggregation, prediction markets, economic mechanisms, incentives, organizational modeling, argumentation, contracts, norms, mobility and social context, sociotechnical systems, and software engineering with and for social computing. This course incorporates ideas from diverse disciplines (including sociology, psychology, law, economics, political science, logic, statistics, philosophy, business) to provide essential background for future computer science careers in industry and research.

Prerequisite: CSC 226 and CSC 316
Typically offered in Fall only

CSC 456 Computer Architecture and Multiprocessors (3 credit hours)
Major components of digital computers and the organization of these components into systems. Begins with single processor systems and extends to parallel systems for multiprocessing. Topics include computer organization, instruction set design, cache memory, pipelined processors, and multiprocessors. Recent developments in PC and desktop architectures are also studied.

Prerequisite: CSC 236 and CSC 316
Typically offered in Fall only

CSC 461 Computer Graphics (3 credit hours)
Principles of computer graphics with emphasis on two-dimensional and aspects of three-dimensional raster graphics. Topics include: graphics hardware devices, lines and polygons, clipping lines and polygons to windows, graphical user interface, vectors, projections, transformations, polygon fill. Programming projects in C or C++.

Prerequisite: MA 305 or MA 405 and CSC 230 or ECE 209 and CSC 316 or ECE 309
Typically offered in Fall only

CSC 462 Advanced Computer Graphics Projects (3 credit hours)
Principles of computer graphics with emphasis on three-dimensional graphics. Topics include: 3-D projections and transformations, curves and surfaces, color and texture, animation, visualization, and global illumination techniques. Programming project required.

Prerequisite: CSC 461
Typically offered in Spring only

CSC 467 Multimedia Technology (3 credit hours)
Methods of creating, recording, compressing, parsing, editing and playing back on a computer the following media: sound, music, voice, graphics, images, video, and motion. Introduction to basic principles: signal processing, information theory, real-time scheduling. Also includes discussion of standards, programming tools and languages, storage and I/O devices, networking support, legal issues, user interfaces, and applications. Includes significant hands-on experience.

Prerequisite: CSC 246
Typically offered in Spring only

CSC 471 Modern Topics in Cybersecurity (3 credit hours)
Exploration of three modern or emerging topics in Cybersecurity beyond the core cybersecurity curriculum. These topics may vary by semester. Enrollment is open to CSC majors only.

Prerequisite: CSC 405; Corequisite: CSC 474
Typically offered in Fall only

CSC 472 Cybersecurity Projects (3 credit hours)
Application of cybersecurity principles and basic computer science to solve a cybersecurity problem. Project with comprehensive written and oral project report is required. Enrollment is open to CSC majors only.

Prerequisite: CSC 471 and Senior Status
Typically offered in Spring only

CSC 474 Network Security (3 credit hours)
Basic concepts and techniques in information security and management such as risks and vulnerabilities, applied cryptography, authentication, access control, multilevel security, multilateral security, network attacks and defense, intrusion detection, physical security, copyright protection, privacy mechanisms, security management, system assurance and evaluation, and information warfare. Coverage of high-level concepts such as confidentiality, integrity, and availability applied to hardware, software, and data. Credit not allowed for both CSC 474 and CSC 574.

Prerequisite: CSC 230 or ECE 209
Typically offered in Fall only

CSC 481/CSC 581 Game Engine Foundations (3 credit hours)
In this course we will examine some of the components of a commercial strength game engine. We will survey different genres of games, using some of the unique design challenges each genre provides as a motivation for an in-depth examination of the affordances games engines provide for designing games of that genre. We will cover topics ranging from data structures, resource management, game loops and logical timing systems, scripting, error logging, and networking. A sequence of programming assignments will lead students through the implementation of their own game engine, which they will use to design their own game.

Prerequisite: CSC 316 or ECE 309; Restriction: CSC Majors Only
Typically offered in Fall only

CSC 482 Advanced Computer Game Projects (3 credit hours)
Principles of computer game development with emphasis on 3D first-person game engines. Topics include: advanced character behavior control, procedural content generation, large scale mulit-player game design and infrastructure, serious games for education, training and other applications, the game production pipeline and project built on top of a commercial game engine. Consideration of the game production pipeline, including project pitches, requirements and design detail. Programming project with written and oral reporting is required. Enrollment open to CSC majors only.

Prerequisite: CSC 481
Typically offered in Spring only

CSC 484/CSC 584 Building Game AI (3 credit hours)
In this course we will examine Artificial Intelligence (AI) techniques that are used in the design of computer games. We will look at techniques for game playing as well as the design of AI opponents tasked with creating "good experiences" for players. The course will begin with a discussion of general AI, common algorithms, data structures, and representations. From there, we will cover topics in character movement, pathfinding, decision making, strategy, tactics, and learning. In a sequence of programming assignments students will create increasingly sophisticated AI implementations. Students will also critically review the projects conducted by graduate students enrolled in CSC584. CSC majors only. Students cannot get credit for both CSC 484 and CSC 584.

Prerequisite: CSC 316
Typically offered in Spring only

CSC 486 Computational Visual Narrative (3 credit hours)
Computational Visual Narrative is a project-based course for developing computational media with visual computing tools such as game engines. Within this course we will gain familiarity with the repertoire and practice of individuals involved in the design and development of digital interactive experiences. In the process, you will gain an understanding of the underlying concepts, techniques and technologies of computational and digital systems, software development and its role and potential in narrative practice.

Prerequisite: CSC 316 or ECE 309
Typically offered in Spring only

CSC 492 Senior Design Project (3 credit hours)
Application of software engineering principles and basic computer science to the total development of a software system. Consideration of the software system design process, including requirements and design detail. Development and evaluation of a prototype accomplished through design team activity. Comprehensive written and oral project report is required. Open to CSC majors. Restricted to students with 6 hours of Computer Science Restricted Elective.

Prerequisite: CSC 326
Typically offered in Fall and Spring

CSC 495 Special Topics in Computer Science (1-6 credit hours)
Topics of current interest in computer science not covered in existing courses. Each special topics course will have one or more prerequisites from the Computer Science core courses. CSC 495 may be repeated for credit if a different topic is chosen.

Typically offered in Fall, Spring, and Summer

CSC 498 Independent Study in Computer Science (1-6 credit hours)
Detailed investigation of computing topics of particular interest to advanced undergraduate computer science majors under faculty direction. Appropriate topics may include software development projects, tutorial work on new or emerging technologies, or exploration of an emerging computing topic. The experience must be arranged in advance by the student and approved by the Department of Computer Science prior to enrollment. A minimum of 45 hours must be completed for each credit hour earned. An independent study proposal and final report approved by the faculty mentor and the department are required. Individualized/Independent Study courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department. At most 6 credit hours of CSC 498 and/or CSC 499 may be applied to degree.

Typically offered in Fall, Spring, and Summer

CSC 499 Independent Research in Computer Science (1-6 credit hours)
Independent investigation of a research problem under the supervision of a faculty member in the Department of Computer Science. The experience must be arranged in advance by the student and approved by the Department of Computer Science prior to enrollment. A minimum of 45 hours must be completed for each credit hour earned. An independent research proposal and final report approved by the faculty mentor and the department are required. Individualized/Independent Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" to be completed by the student and faculty member prior to registration by the department. At most 6 credit hours of CSC 498 and/or CSC 499 may be applied to degree.

Typically offered in Fall, Spring, and Summer

CSC 501 Operating Systems Principles (3 credit hours)
Fundamental issues related to the design of operating systems. Process scheduling and coordination, deadlock, memory management and elements of distributed systems.

Prerequisite: CSC 246, CSC 316 and MA 421
Typically offered in Fall and Spring

CSC 503 Computational Applied Logic (3 credit hours)
Introduction to the conceptual and formal apparatus of mathematical logic, to mathematical concepts underlying the process of logical formalization, and to the applications of various logics across a broad spectrum of problems in computer science and artificial intelligence.

Prerequisite: CSC 333 of LOG 335 or LOG 435
Typically offered in Fall only

CSC 505 Design and Analysis Of Algorithms (3 credit hours)
Algorithm design techniques: use of data structures, divide and conquer, dynamic programming, greedy techniques, local and global search. Complexity and analysis of algorithms: asymptotic analysis, worst case and average case, recurrences, lower bounds, NP-completeness. Algorithms for classical problems including sorting, searching and graph problems (connectivity, shortest paths, minimum spanning trees).

Prerequisite: CSC 316 and CSC 226
Typically offered in Fall, Spring, and Summer

CSC 506/ECE 506/ECE 406/CSC 406 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall, Spring, and Summer

CSC 510 Software Engineering (3 credit hours)
An introduction to software life cycle models; size estimation; cost and schedule estimation; project management; risk management; formal technical reviews; analysis, design, coding and testing methods; configuration management and change control; and software reliability estimation. Emphasis on large development projects. An individual project required following good software engineering practices throughout the semester.

Prerequisite: CSC 316 and CSC 226
Typically offered in Fall and Spring

CSC 512/CSC 412 Compiler Construction (3 credit hours)
The course will concentrate on the theory and practice of compiler-writing. Topics to be covered will include techniques for parsing, code generation, and optimization. Furthermore, the theoretical underpinnings of compilers such as LR parsing will be covered. Finally, the students will be exposed to compiler construction tools, and will obtain hands-on experience in building a compiler for a small programming language. Besides the listed prerequisite courses, other helpful courses include CSC 253, CSC 224, CSC 234, and MA 121.

Prerequisites: Graduate standing and CSC 316 and CSC 333 or equivalent classes.
Typically offered in Fall only

CSC 513 Electronic Commerce Technology (3 credit hours)
Exploration of technological issues and challenges underlying electronic commerce. Distributed systems; network infrastructures; security, trust, and payment solutions; transaction and database systems; and presentation issues. Project required. No Audits.

Prerequisite: CSC 501
Typically offered in Spring only

CSC 514/MA 414/MA 514/CSC 414 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.

Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

CSC 515 Software Security (3 credit hours)
Introduces students to the discipline of designing, developing, and testing secure and dependable software-based systems. Students will learn about risks and vulnerabilities, and effective software security techniques. Topics include common vulnerabilities, access control, information leakage, logging, usability, risk analysis, testing, design principles, security policies, and privacy. Project required.

Prerequisite: CSC 510
Typically offered in Spring only

CSC 517/ECE 517 Object-Oriented Design and Development (3 credit hours)
The design of object-oriented systems, using principles such as the GRASP principles, and methodologies such as CRC cards and the Unified Modeling Language (ULM). Requirements analysis. Design patterns Agile Methods. Static vs. dynamic typing. Metaprogramming. Open-source development practices and tools. Test-first development. Project required, involving contributions to an open-source software project.

Prerequisite: CSC 326 or ECE 309
Typically offered in Fall and Spring

CSC 519 DevOps: Modern Software Engineering Practices (3 credit hours)
Modern software development organizations require entire teams of DevOps to automate and maintain software engineering processes and infrastructure vital to the organization. In this course, you will gain practical exposure to the skills, tools, and knowledge needed in automating software engineering processes and infrastructure. Students will have the chance to build new or extend existing software engineering tools and design a DevOps pipeline.

Prerequisite: CSC 510 or (graduate or senior standing with at least a 3.0 GPA) and good knowledge of at least one high level programming language
Typically offered in Fall and Spring

CSC 520 Artificial Intelligence I (3 credit hours)
Introduction to and overview of artificial intelligence. Study of AI programming language such as LISP or PROLOG. Elements of AI problem-solving technique. State spaces and search techniques. Logic, theorem proving and associative databases. Introduction to knowledge representation, expert systems and selected topics including natural language processing, vision and robotics.

Prerequisite: CSC 316 and either CSC 226 or LOG 201 or LOG 335 or background in symbolic logic
Typically offered in Fall and Spring

CSC 522/CSC 422 Automated Learning and Data Analysis (3 credit hours)
This course provides an introduction to concepts and methods for extracting knowledge or other useful forms of information from data. This activity, also known under names including data mining, knowledge discovery, and exploratory data analysis, plays an important role in modern science, engineering, medicine, business, and government. Students will apply supervised and unsupervised automated learning methods to extract patterns, make predictions and identify groups from data. Students will also learn about the overall process of data collection and analysis that provides the setting for knowledge discovery, and concomitant issues of privacy and security. Examples and projects introduce the students to application areas including electronic commerce, information security, biology, and medicine. Students cannot get credit for both CSC 422 and CSC 522.

Prerequisite: CSC 226 or LOG 201, ST 370, MA 305 or MA 405
Typically offered in Fall and Spring

CSC 530 Computational Methods for Molecular Biology (3 credit hours)
Computer algorithms supporting genomic research: DNA sequence comparison and assembly, hybridization mapping, phylogenetic reconstruction, genome rearrangement, protein folding and threading.

Prerequisite: CSC 316, Corequisite: CSC 505
Typically offered in Fall only

CSC 533 Privacy in the Digital Age (3 credit hours)
Privacy is a growing concern in our modern society. We interact and share our personal information with a wide variety of organizations, including financial and healthcare institutions, web service providers and social networks. Many times such personal information is inappropriately collected, used or shared, often without our awareness. This course introduces privacy in a broad sense, with the aim of providing students an overview of the challenging and emerging research topics in privacy. This course will expose students to many of the issues that privacy engineers, program managers, researchers and designers deal with in industry. ST 370 is recommended but not mandatory.

Prerequisite: CSC 316
Typically offered in Fall only

CSC 537 Systems Attacks and Defenses (3 credit hours)
This class will: explore several aspects of security research with the goal of understanding the attacker's mindset; help the students to develop a foundation and a well-rounded view of security research; and cover some of the state-of-the-art attack/defense techniques and ongoing research activities in a number of topics in software security, web security, privacy and network security.

P: CSC 246 and CSC 401 or equivalent
Typically offered in Spring only

CSC 540 Database Management concepts and Systems (3 credit hours)
Advanced database concepts. Logical organization of databases: the entity-relationship model; the relational data model and its languages. Functional dependencies and normal forms. Design, implementation, and optimization of query languages; security and integrity, consurrency control, transaction processing, and distributed database systems.

Prerequisite: CSC 316
Typically offered in Fall and Spring

CSC 541 Advanced Data Structures (3 credit hours)
Complex and specialized data structures relevant to design and development of effective and efficient software. Hardware characteristics of storage media. Primary file organizations. Hashing functions and collision resolution techniques. Low level and bit level structures including signatures, superimposed coding, disjoint coding and Bloom filters. Tree and related structures including AVL trees, B*trees, tries and dynamic hashing techniques.

Prerequisite: CSC 316
Typically offered in Spring only

CSC 546/ISE 546 Management Decision and Control Systems (3 credit hours)
Planning, design, and development and implementation of comprehensive computer-based information systems to support management decisions. Formal information systems principles; information requirements analysis; knowledge acquisition techniques; information modeling. Information resource management for quality operational control and decision support; system evaluation, process improvement and cost effectiveness.

Prerequisite: CSC 423 or BUS 541
Typically offered in Fall only

CSC 547/ECE 547 Cloud Computing Technology (3 credit hours)
Study of cloud computing principles, architectures, and actual implementations. Students will learn how to critically evaluate cloud solutions, how to construct and secure a private cloud computing environment based on open source solutions, and how to federate it with external clouds. Performance, security, cost, usability, and utility of cloud computing solutions will be studied both theoretically and in hands-on exercises. Hardware-, infrastructure-, platform-, software-, security-, - "as-a-service".

Prerequisites: CSC 501 and either ECE/CSC 570 or ECE/CSC 573
Typically offered in Spring only

CSC 548 Parallel Systems (3 credit hours)
Basic concepts of parallel computation; parallel programming models and algorithm design; load balancing and performance optimization; parallel I/0 and high-end storage systems; high performance parallel applications.

Prerequisite: CSC 246 or CSC 451 or CSC 501
Typically offered in Fall only

CSC 554 Human-Computer Interaction (3 credit hours)
Basic theory and concepts of human-computer interaction. Human and computational aspects. Cognitive engineering. Practical HCI skills. Significant historical case studies. Current technology and future directions in user interface development.

Prerequisite: CSC 316
Typically offered in Spring only

CSC 555 Social Computing and Decentralized Artificial Intelligence (3 credit hours)
This course surveys the field of social computing, introducing its key concepts, paradigms, and techniques. Specific topics are selected from the following list: social media and social network analytics, sociological underpinnings, crowdsourcing and surveys, human computation, social mobilization, human decision making, voting theory, judgment aggregation, prediction markets, economic mechanisms, incentives, organizational modeling, argumentation, contracts, norms, mobility and social context, sociotechnical systems, and software engineering with and for social computing. This course incorporates ideas from diverse disciplines (including sociology, psychology, law, economics, political science, logic, statistics, philosophy, business) to provide essential background for future computer science careers in industry and research.

Typically offered in Fall only

CSC 561 Principles of Computer Graphics (3 credit hours)
Fundamentals of the OpenGL API. 2D and 3D transformations, perspective and orthographic projection, and the mathematical foundations that underlie these concepts. Geometric primitives, clipping, depth buffering, scan conversion, and rasterization. Lighting, shadows, and texture mapping. Curves and surfaces.

Prerequisite: CSC Majors
Typically offered in Fall only

CSC 562 Introduction to Game Engine Design (3 credit hours)
This course offers an advanced discussion of topics in computer graphics, with an emphasis on rendering techniques and GPU shader programming used in computer game engine design. Students are required to implement a medium-size game program that includes modeling and rendering, 2D physics, and animation of dynamic objects. Students will learn about GPU basics, mathematics of transformations, visual appearance properties, texturing, global illumination, and toon shading in computer games.

Prerequisites: CSC 561 or CSC 461 or equivalent course from a previous university
Typically offered in Spring only

CSC 563 Visual Interfaces for Mobile Devices (3 credit hours)
The conception and creation of effective visual interfaces for mobile devices, including ideation and prototyping for useful mobile applications, the industry and architecture of mobile devices, mobile usage context, computer graphics and interfaces for mobiles, and mobile programming.

Prerequisite: CSC 554 or CSC 561
Typically offered in Spring only

CSC 565/MA 565/OR 565 Graph Theory (3 credit hours)
Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matchings and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.

Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

CSC 568 Enterprise Storage Architecture (3 credit hours)
An introduction to storage systems architecture in an enterprise. Begins with a review of the individual components of a system (eg, hard disk drives, network interfaces), and shows how to aggregate those into storage systems. Tradeoffs involving factors such as cost, complexity, availability, power and performance. Discussion of information management strategies, including data migration. Guest lectures by representatives from local industry. Students work in teams on a semester-long project.

Prerequisite: CSC 246 and CSC 401 and CSC 316
Typically offered in Spring only

CSC 570/ECE 570 Computer Networks (3 credit hours)
General introduction to computer networks. Discussion of protocol principles, local area and wide area networking, OSI stack, TCP/IP and quality of service principles. Detailed discussion of topics in medium access control, error control coding, and flow control mechanisms. Introduction to networking simulation, security, wireless and optical networking.

Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing
Typically offered in Fall and Spring

CSC 573/ECE 573 Internet Protocols (3 credit hours)
Principles and issues underlying provision of wide area connectivity through interconnection of autonomous networks. Internet architecture and protocols today and likely evolution in future. Case studies of particular protocols to demonstrate how fundamental principles applied in practice. Selected examples of networked clinet/server applications to motivate the functional requirements of internetworking. Project required.

Prerequisite: CSC/ECE 570
Typically offered in Fall, Spring, and Summer

CSC 574/ECE 574 Computer and Network Security (3 credit hours)
This course presents foundational concepts of computer and network security and privacy. It covers a wide breadth of concepts, including; Fundamentals of computer security and privacy, including security models, policies, and mechanisms; Cryptography for secure systems, including symmetric and asymmetric ciphers, hash functions, and integrity mechanisms; Authentication of users and computers; Network attacks and defenses at the network and application layers; Common software vulnerabilities and mitigation strategies; Secure operating systems and seminal access control models and policies; Principles of intrusion detection; Privacy, including considerations of end-user technologies.

Prerequisite: (CSC 316 or ECE309) and (CSC 401 or ECE407) or equivalent
Typically offered in Fall and Spring

CSC 575/ECE 575 Introduction to Wireless Networking (3 credit hours)
Introduction to cellular communications, wireless local area networks, ad-hoc and IP infrastructures. Topics include: cellular networks, mobility mannagement, connection admission control algorithms, mobility models, wireless IP networks, ad-hoc routing, sensor networks, quality of service, and wireless security.

Prerequisite: ECE/CSC 570
Typically offered in Spring only

CSC 576/ECE 576 Networking Services: QoS, Signaling, Processes (3 credit hours)
Topics related to networking services, signaling for setting up networking services, such as SIP and IMS, networking architectures for providing QoS for networking services, such as MPLS, DiffServ and RAC, signaling protocols for setting up QoS connections in the transport stratum, such as LDP and RSVP-TE, video-based communications, and capacity planning models for dimensioning services.

Prerequisite: CSC/ECE 570
Typically offered in Fall and Spring

CSC 577/ECE 577 Switched Network Management (3 credit hours)
Topics related to design and management of campus enterprise networks, including VLAN design; virtualization and automation methodologies for management; laboratory use of open space source and commercial tools for managing such networks.

Typically offered in Fall only

CSC 579/ECE 579/OR 579 Introduction to Computer Performance Modeling (3 credit hours)
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

CSC 580/MA 580 Numerical Analysis I (3 credit hours)
Algorithm behavior and applicability. Effect of roundoff errors, systems of linear equations and direct methods, least squares via Givens and Householder transformations, stationary and Krylov iterative methods, the conjugate gradient and GMRES methods, convergence of method.

Prerequisite: MA 405; MA 425 or MA 511; high-level computer language
Typically offered in Fall only

CSC 581/CSC 481 Game Engine Foundations (3 credit hours)
In this course we will examine some of the components of a commercial strength game engine. We will survey different genres of games, using some of the unique design challenges each genre provides as a motivation for an in-depth examination of the affordances games engines provide for designing games of that genre. We will cover topics ranging from data structures, resource management, game loops and logical timing systems, scripting, error logging, and networking. A sequence of programming assignments will lead students through the implementation of their own game engine, which they will use to design their own game.

Prerequisite: CSC 316 or ECE 309; Restriction: CSC Majors Only
Typically offered in Fall only

CSC 582 Computer Models of Interactive Narrative (3 credit hours)
A theoretical and practical study of the computational models supporting the creation of interactive narrative systems. Topics include basic introductions to cognitive, linguistic and film theoretic models of narrative; representations and reasoning techniques from artificial intelligence related to the creation of storylines, dialog, camera control and other features of narrative in text-based and/or 3D virtual worlds; mechanisms for controlling character behavior in multi-agent multi-user stories; and applications of these techniques ranging from interactive entertainment to educational software to training simulations.

Typically offered in Fall only

CSC 583/MA 583 Introduction to Parallel Computing (3 credit hours)
Introduction to basic parallel architectures, algorithms and programming paradigms; message passing collectives and communicators; parallel matrix products, domain decomposition with direct and iterative methods for linear systems; analysis of efficiency, complexity and errors; applications such as 2D heat and mass transfer.

Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580
Typically offered in Spring only

CSC 584/CSC 484 Building Game AI (3 credit hours)
In this course we will examine Artificial Intelligence (AI) techniques that are used in the design of computer games. We will look at techniques for game playing as well as the design of AI opponents tasked with creating "good experiences" for players. The course will begin with a discussion of general AI, common algorithms, data structures, and representations. From there, we will cover topics in character movement, pathfinding, decision making, strategy, tactics, and learning. In a sequence of programming assignments students will create increasingly sophisticated AI implementations. Students will also critically review the projects conducted by graduate students enrolled in CSC584. CSC majors only. Students cannot get credit for both CSC 484 and CSC 584.

Prerequisite: CSC 316
Typically offered in Spring only

CSC 591 Special Topics In Computer Science (1-6 credit hours)
Topics of current interest in computer science not covered in existing courses.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

CSC 595 Cybersecurity Practicum (3 credit hours)
Application of cybersecurity principles and computer science and engineering to solve a cybersecurity problem. A project with comprehensive written and oral project report is required. Enrollment is open to Graduate Certificate in Cybersecurity (CYS GCP) students and CSC and ECE majors only.

Prerequisite: CSC/ECE 574
Typically offered in Fall only

CSC 600 Computer Science Graduate Orientation (1 credit hours)
Introduction for new graduate students to (a) information about graduate program, department, and university resources, and (b) research projects conducted by CSC faculty.

Typically offered in Fall and Spring

CSC 630 Master's Independent Study (1-3 credit hours)
Individual investigation of topics under the direction of member(s) of the graduate faculty.

Typically offered in Fall, Spring, and Summer

CSC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CSC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CSC 705 Operating Systems Security (3 credit hours)
Fundamentals and advanced topics in operating system (OS) security. Study OS level mechanisms and policies in investigating and defending against real-world attacks on computer systems, such as self-propagating worms, stealthy rootkits and large-scale botnets. OS security techniques such as authentication, system call monitoring, as well as memory protection. Introduce recent advanced techniques such as system-level randomization and hardware virtualization.

Prerequisite: CSC 501
Typically offered in Spring only

CSC 707 Automata, Languages and Computability Theory (3 credit hours)
Formal models of language and computation; finite automata and regular languages, pushdown automata and context-free languages, Turing machines. Relative power of models, Chomsky hierarchy. Inherent complexity of problems: undecidability, computational complexity, intractable problems.

Prerequisite: CSC 226 required, CSC 333 recommended
Typically offered in Fall only

CSC 710 Software Engineering as a Human Activity (3 credit hours)
This course addresses the human aspect of software engineering, by studying the people who practice it. Students will explore software engineering as traditionally defined, and also consider techniques that transform how we understand software engineering, such as methods from psychology and sociology. Students will study the usability of software engineering tools, the psychology of programming, performance of software developers, experimental methods in observing software engineers, distributed development and coordination, and cultural differences between software developers.

Prerequisite: CSC 510
Typically offered in Spring only

CSC 711/GIS 711 Geospatial Data Management (3 credit hours)
Data management principles and technologies for efficient implementation of geospatial applications. This course introduces students to: spatial and temporal data types, data models, geometry models, spatial predicates, spatial access methods, and spatial query processing. In addition, students will be exposed to modern data management systems for geospatial application development and data integration principles. Prior GIS programming knowledge and knowledge of database management systems and SQL is preferred.

Typically offered in Spring only

CSC 712 Software Testing and Reliability (3 credit hours)
An advanced introduction to software testing and reliability. The course is a balanced mixture of theory, practice, and application. Methods, techniques, and tools for testing software and producing reliable and secure software are used and analyzed. Software reliability growth models and techniques for improving and predicting software reliability are examined, and their practical use is demonstrated. Good knowledge of C++ or Java. Knowledge of the basics of statistics, calculus, and linear algebra.

Prerequisite: CSC 510
Typically offered in Fall only

CSC 714 Real Time Computer Systems (3 credit hours)
Design and implementation of computer systems required to provide specific response times. Structure of a real-time kernel, fixed and dynamic priority scheduling algorithms, rate monotonic scheduling theory, priority inheritance protocols, real-timebenchmarks, case study of a real-time kernel.

Prerequisite: CSC 451 or CSC 501
Typically offered in Spring only

CSC 720 Artificial Intelligence II (3 credit hours)
A second course in artificial intelligence emphasizing advanced concepts of AI including logic programming, automatic programming, natural language understanding, visual perception by machine, learning and inference, intelligent computer-aided instruction, knowledge representation, robotics and other topics to be chosen by instructor. Students asked to write programs in AI programming language such as LISP and PROLOG.

Prerequisite: CSC 520
Typically offered in Spring only

CSC 722 Advanced Topics in Machine Learning (3 credit hours)
A broad range of advanced topics in machine learning, the building of computer-based systems that can adapt to their environment and learn from their own experience. Theory of learnability, technical details of various learning methods, combination of multiple methods, evaluation of methods, and related topics (at the discretion of the instructor).

Prerequisite: CSC 520
Typically offered in Fall only

CSC 724 Advanced Distributed Systems (3 credit hours)
Principles in the design and implementation of modern distributed systems; recent techniques used by real-world distributed systems such as peer-to-peer file sharing, enterprise data center, and internet search engines; state-of-the-art architectures, algorithms, and performance evaluation methodologies in distributed systems.

Prerequisite: CSC 501 or equivalent. Programming in C++ or Java in Unix environments
Typically offered in Spring only

CSC 742 Database Management Systems (3 credit hours)
Database concepts. Database design. Data models: entity-relationship and relational. Data manipulation languages including SQL. Data Dictionaries. Query processing. Concurrency. Software development environments using a database system. Expert, object-oriented, multimedia and distributed database systems. Database systems architecture. Use of a commercial database management system.

Prerequisite: CSC 431 or 541
Typically offered in Spring only

CSC 743 Secure Data Management (3 credit hours)
Advanced topics in secure data management with techniques in traditional database management systems as well as in recent advances in emerging areas. Emphasis on new security issues and challenges imposed by the Internet and the Web on cross-organization data sharing and management. Example topics include XML, data management in P2P, trust management, data authorship, and the integration of security and privacy policies with information systems.

Prerequisite: CSC/ECE 574 and (CSC 440 or CSC 540). Background in databases and basic security concepts required.
Typically offered in Fall only

CSC 750 Service-Oriented Computing (3 credit hours)
Concepts, theories, and techniques for computing with services. This course examines architectures for Web applications based on the classical publish, find, and bind triangle, but formulates it at a higher level. It considers sophisticated approaches for the description, discovery, and engagement of services, especially over the Web and the Grid. This course emphasizes service composition. Key topics include semantics, transactions, processes, agents, quality of service, compliance, and trust.

Prerequisite: CSC 540: Database Management Concepts and Systems
Typically offered in Fall only

CSC 761 Advanced Topics in Computer Graphics (3 credit hours)
Understanding and discussing current advances and research topics in computer graphics. Possible topics include nonphotorealistic rendering, modeling natural phenomena, illumination and rendering techniques, model simplification, animation, visualization, graphics hardware. Learning to critique research papers from important venues in the computer graphics field. Learning to read, interpret, and present computer graphics research papers in a conference-type environment.

Prerequisite: Graduate standing in Computer Science
Typically offered in Spring only

CSC 762/OR 762/ISE 762 Computer Simulation Techniques (3 credit hours)
Basic discrete event simulation methodology: random number generators, generating random objects, design of discrete event simulation, validation, analysis of simulation output, variance reduction techniques, Markov chain Monte Carlo, simulation optimization. The course has computer assignments and projects.

Students should have completed a course on stochastic models (similar to ISE 560 or ISE 760) and have a working knowledge of a programming language (e.g., Python, Matlab, R, or others).
Typically offered in Fall and Spring

CSC 766 Code Optimization for Scalar and Parallel Programs (3 credit hours)
Advanced research issues in code optimization for scalar and parallel programs; program analysis, scalar and parallel optimizations as well as various related advanced topics.

Prerequisite: CSC 512, or CSC 548, or CSC 501
Typically offered in Spring only

CSC 772 Survivable Networks (3 credit hours)
Principles of network and service continuity and related metrics; the theory of network availability, survivability, and restoration; a comprehensive coverage of network architectures, protocols, algorithms, and related technology for survivability; advanced topics in network survivability; hands-on experience in the implementation of protocols and software for survivable systems and the operation of survivable networks.

Typically offered in Spring only

CSC 773/ECE 773 Advanced Topics in Internet Protocols (3 credit hours)
Cutting-edge concepts and technologies to support internetworking in general and to optimize the performance of the TCP/IP protocol suite in particular. Challenges facing and likely evolution for next generation intenetworking technologies. This course investigates topics that include, but may be not limited to: Internet traffic measurement, characteriztion and modeling, traffic engineering, network-aware applications, quality of service, peer-to-peer systems, content-distribution networks, sensor networks, reliable multicast, and congestion control.

Prerequisite: CSC/ECE 573
Typically offered in Spring only

CSC 774/ECE 774 Advanced Network Security (3 credit hours)
A study of network security policies, models, and mechanisms. Topics include: network security models; review of cryptographic techniques; internet key management protocols; electronic payments protocols and systems; intrusion detection and correlation; broadcast authentication; group key management; security in mobile ad-hoc networks; security in sensor networks.

Prerequisite: CSC/ECE 570, CSC/ECE 574
Typically offered in Spring only

CSC 775/ECE 775 Advanced Topics in Wireless Networking (3 credit hours)
Reviews the current state of research in wireless networks, network architectures, and applications of wireless technologies; students will design, organize, and implement or simulate systems in a full-semester research project. For students with background in networking and communications who wish to explore research and development topics.

Prerequisite: ECE/CSC 575
Typically offered in Fall only

CSC 776/ECE 776 Design and Performance Evaluation of Network Systems and Services (3 credit hours)
Introduction to the design and performance evaluation of network services. Topics include top-down network design based on requirements, end-to-end services and network system architecture, service level agreements, quantitative performance evaluation techniques. Provides quantitative skills on network service traffic and workload modeling, as well as, service applications such as triple play, internet (IPTV), Peer-to-peer (P2P), voice over IP (VoIP), storage, network management, and access services.

Prerequisite: CSC(ECE) 570 and CSC(ECE) 579
Typically offered in Spring only

CSC 777/ECE 777 Telecommunications Network Design (3 credit hours)
Analytic modeling and topological design of telecommunications networks, including centralized polling networks, packet switched networks, T1 networks, concentrator location problems, routing strategies, teletraffic engineering and network reliability.

Prerequisite: CSC(ECE) 570
Typically offered in Spring only

CSC 780/MA 780 Numerical Analysis II (3 credit hours)
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.

Prerequisite: MA 580
Typically offered in Spring only

CSC 791 Advanced Topics In Computer Science (1-6 credit hours)
Advanced topics of current interest in computer science not covered by existing courses.

Typically offered in Fall and Spring

CSC 801 Seminar in Computer Science (1-3 credit hours)
Faculty and graduate student research presentations and discussions centered around current research problems in Computer Science and advanced theories in these areas. Students are expected to make presentations of published works and, depending onthe course credit received and their academic degree progress, present their own research results. Critical discussions of the various research approaches and results and their relationships based on the presentations and additional readings and research. Departmental Approval Required.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CSC 830 Doctoral Independent Study (1-3 credit hours)
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.

Typically offered in Fall, Spring, and Summer

CSC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CSC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CSC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Cooperative Education (COP)

COP 100 Co-Op Work lst Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 101 Co-Op Work lst Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 200 Co-Op Work 2nd Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 201 Co-Op Work 2nd Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 300 Co-Op Work 3rd Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 301 Co-Op Work 3rd Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 400 Co-Op Work 4th Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 401 Co-Op Work 4th Par (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 500 Co-Op Work Graduate Alt (0 credit hours)
Typically offered in Fall, Spring, and Summer

COP 501 Co-Op Work Graduate PAR (0 credit hours)
Typically offered in Fall, Spring, and Summer

Counselor Education (ECD)

ECD 220 College Student Development and Peer Counseling (2 credit hours)
Developmental issues of young adulthood with opportunity for the acquisition of paraprofessional counseling skills and crisis intervention skills. Major consideration is given to self-awareness and values clarification through utilization of personality inventories and self-assessment instruments. Priority will be given to resident advisors and students active in student organizations or volunteer programs.

Typically offered in Spring only

ECD 221 Career Planning and Personal Development (3 credit hours)
Knowledge, attitudes, self-understanding, and skills needed to enhance career planning and foster personal development. Study of self-understanding, self-talk, goal setting, the environment, and decision making as ways to adapt more effectively to the challenges of life.

Typically offered in Fall and Spring

ECD 222 Sexual Violence Prevention for Peer Educators (3 credit hours)
This course trains students to educate their peers about sexual and relationship violence and stalking. Students will explore how this violence impacts people of varying cultures including people of color and the gay, lesbian, bisexual, and transgender community. They are taught to be social activists and learn skills to be confident and active bystanders as well as knowledgeable and effective facilitators. Topics include learning about the objectification of women and men in the media, masculinity and patriarchy, pornography, and how these all contribute to a rape culture. Upon successful completion, students will be ready to be a Movement peer educator. Student must complete application and interview process and have been approved by the instructor prior to registration in the course.

Typically offered in Fall only

ECD 224 Student Development and Peer Mentoring (2 credit hours)
For new student peer mentors of primarily African American freshmen. Relevant student development, psychology and counseling research and theory as well as shared professional experiences are presented. Class discussion, group activities, role playing, relevant readings and video are employed. Reaction papers and project are required.

Prerequisite: Selection as a Peer Mentor
Typically offered in Fall only

ECD 225 Foundations of Cultural Competence (3 credit hours)
This course engages students in the process to work effectively with diverse populations to develop cross-cultural competencies and identify culturally-appropriate strategies in the workplace and life. This course introduces multicultural and international diversity concepts while having students participate in reflective and experiential activities. Students gain an overview of historical and psychological conceptual frameworks and models for understanding cultural differences and similarities within, among, and between groups of people domestically and internationally. Sophomore standing or above.

GEP Global Knowledge, GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

ECD 296 Special Topics in Education: Counselor Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the students.

Typically offered in Fall, Spring, and Summer

ECD 310 Caldwell Fellows Honors Seminar: Foundations in Self-Development (3 credit hours)
Students are selected as Caldwell Fellows on the basis of their potential for effective leadership. The Caldwell seminar is the foundational experience for all Fellows, grounding them the essential gounding of leadership - self-understanding. The course employs theory and practice for psychosocial development, grounding in the servant-leader philosophy of leadership, and practice in engaged social issues leadership through service-learning and reflection.

Requisite: Caldwell Fellows Only
GEP U.S. Diversity
Typically offered in Fall only

ECD 510 Orientation to Professional Counseling, Identity, and Ethics (3 credit hours)
This course examines (1) the purpose of counseling, (2) the historical context for counseling, (3) the basic principles of major counseling theories, and (4) the practice of counseling in various professional settings.

Prerequisite: 6 credits in ED or PSY
Typically offered in Spring and Summer

ECD 524 Career Counseling and Development (3 credit hours)
Knowledge and skills needed to: (a) provide professional career counseling to individuals and (b) design, implement and evaluate career development programs for particular groups. Theories of career development and decision making; career guidance programs in educational, agency and industrial setting; career information sources and delivery systems; and assessment in career counseling.

Prerequisite: 6 credits in ED or PSY
Typically offered in Fall, Spring, and Summer

ECD 525 Multicultural Counseling (3 credit hours)
Theory and practice of counseling culturally diverse clients. Client populations include African Americans, Asian-Americans, American Indians and Hispanics. Cultural assumptions, cultural values, counselor credibility, prejudice and racism in context of counseling.

Prerequisite: Six hrs. in ED or PSY, Corequisite: ECD 530
Typically offered in Fall, Spring, and Summer

ECD 530 Theories and Tech of Counseling (4 credit hours)
Theory, philosophy, roles, professional ethics, and techniques of counseling. Eleven major counseling approaches including behavioral, psychoanalytic, client-centered, existential, family and post-modern approaches, and related counseling strategies are discussed. Students have opportunities to practice related strategies through role-plays.

Prerequisite: 6 credits in ED or PSY
Typically offered in Fall and Spring

ECD 533 Int Sch Counseling (4 credit hours)
An examination of the conceptual framework for the role and functions of school counselors, prevention and treatment strategies, program development and evaluation. Focus is on the school-college-community collaboration model, preparing counselors who can work effectively across different counseling settings by collaborating with other counselors and mental health professionals. Graduate standing required.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ECD 535 Introduction to College Counseling and Student Development (4 credit hours)
College Counseling and student development theory, research and practice as well as overview of profession. Discussion of counselor roles, professional ethics, history, identity, and development. Instruction in and design of structured group work in laboratory.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

ECD 536 Introduction to Clinical Mental Health Counseling (4 credit hours)
Issues, functions and scope of work being done in various clinical mental health programs; overview of helping approaches with selected client populations; related professional concerns. Instruction in and design of structured group work in laboratory.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

ECD 539 Group Counseling (3 credit hours)
Theory and practice of group counseling. Theoretical positions include client-centered, behavioral and rational-emotive. Aspects of group process include group leadership, group membership, establishing and maintaining a group.

Prerequisite: ECD 530 and one of the following: ECD 510, 534, 535 or 536
Typically offered in Fall, Spring, and Summer

ECD 540/WGS 540 Gender Issues In Counseling (3 credit hours)
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

Prerequisite: Graduate standing or Six hrs. in ED or PSY
Typically offered in Summer only

ECD 541 Substance Abuse and Counseling (3 credit hours)
This course explores counseling as it relates to working with clients with substance abuse disorders. Ethical and legal issues, theoretical models, assessment and diagnosis, treatment planning, techniques and individual/family/group interventions with diverse populations will be discussed throughout class sessions. This course is distinctively geared towards students who are training to be counselors. Substance abuse issues that clients might present within counseling are addressed by way of assigned readings, class discussions, video segments, case studies, internet resources and assignments.

Prerequisite: 6 hours of Graduate Coursework
Typically offered in Fall and Summer

ECD 542 Research in Counseling (3 credit hours)
This introductory graduate level course in research in counseling is intended to provide students with an overview of the fundamentals of research methods and program evaluations in the field. Students will be able to identify various research approaches and the strengths and limitations associated to them. The course is also designed to give students the basic skills to conduct research in counseling and develop program evaluation skills.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Fall and Summer

ECD 543 Introduction to College Counseling (3 credit hours)
A course designed for investigation of college counseling services and strategies. Assessment and research in student development, and students design and implement a developmental intervention based on Knefelkamp and Wells' Practice-to-Theory-to-Practice model.

Prerequisite: ECD 535 or Doctoral student
Typically offered in Spring only

ECD 545 Counseling Couples and Families (3 credit hours)
This elective course explores counseling as it relates to working with couples and families. Theoretical models, techniques and interventions will be discussed throughout class sessions. This course is distinctively geared towards students who are training to be counselors. Family and couples issues that clients might present within counseling are addressed by way of class discussions, assigned readings, video segments, case studies, role plays and Internet resources.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Spring and Summer

ECD 546 Crisis Interventions in Counseling (3 credit hours)
An overview of crisis intervention and theoretical models. Crisis situations are described across developmental age-span across a variety of service delivery settings. Students will develop conceptual competency for professional counselors to engage in crisis intervention.

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Fall and Summer

ECD 547 Counseling Children and Adolescents (7 credit hours)
Counseling children and adolescents can be very different from working with adults. This course will explore some key developmental considerations, as well as creative approaches to working with this population (ages 0-18). Some topics that will be covered include early interventions, developmental milestones, working with parents, transitions, behavioral changes, peer relationships, sexuality, crisis counseling, ethics, advocacy, and collaborating with other professionals. In addition, common diagnoses and disorders corresponding with each stage of development will also be explored, as well as evidence-based interventions for working with each developmental stage (e.g., bibliotherapy, play therapy, music and art as adjunctive tools, behavior interventions, etc.).

Prerequisite: 6 hours of ECD Graduate Courses
Typically offered in Summer only

ECD 561 Strategies for Clinical Assessment in Counseling (3 credit hours)
Exploration of meaning and importance of assessment in the counseling process. The utilization of counseling assessments based on legal and ethical guidelines and cultural considerations. Identify, interpret, and explain assessments in clinical, college, and school counseling settings.

R: Graduate Students Only
Typically offered in Spring and Summer

ECD 562 Techniques in Counseling (4 credit hours)
In this course students work towards mastery of counseling skills, review relevant theories, and prepare for Practicum. Students will practice counseling skills in class and spend their out of class lab hours practicing skills in partnering schools. Students will do some limited video taping of counseling sessions and receive feedback on tapes from Counselor Education doctoral students taking their supervision theory class.

Prerequisite: ECD 530
Typically offered in Fall only

ECD 575/EDP 575 Multicultural Lifespan Development (3 credit hours)
This course surveys theories, principles, and issues of psychological development throughout the lifespan. Emphasis will be placed on understanding current developmental research and its application to the enhancement of development from birth to late adulthood. Implications for helping professionals working in multicultural contexts will be provided.

Prerequisite: Six Hours of Graduate Study
Typically offered in Fall, Spring, and Summer

ECD 590 Special Problems In Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.

Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall and Spring

ECD 620 Special Problems In Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.

Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall, Spring, and Summer

ECD 642 Practicum In Counseling (3 credit hours)
Student participation in individual and group counseling and consultation experiences under supervision in a school, college or agency setting.
Prerequisite: 1. Completion of all ECD, PSY, and STAT courses with exception of ECD 539 Group Counseling that may be taken concurrently. [Other classes that could be taken concurrently PSY 535,582, 584, 475, 476] 2. Consent of concentration coordin

Prerequisite: ECD 641
Typically offered in Spring only

ECD 651 Internship in School Counseling (6-12 credit hours)
A 600-hour internship for school counselors in training in a school setting under the supervision of qualified professionals. Students perform a variety of activities expected fo school counselors. Weekly meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring

ECD 652 Internship In College Counseling and Student Development (6-12 credit hours)
A 600-hour internship, Professional experience in student affairs department with on-site supervision from qualified professional. Expectations including employment of broad repertoire of skills in roles of counselor, student development educator and administrator. Weekly student meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring

ECD 653 Internship In Clinical Mental Health Counseling (6-12 credit hours)
A 600-hour internship for community agency counselors in agency counseling setting under supervision of qualified professional. Employment of broad repertoire of primary and secondary prevention approaches to individual and group techniques, workshop leadership skills, consultation techniques and advocacy methods. Weekly meetings with faculty and on-site supervisors.

Prerequisite: ECD 642
Typically offered in Fall and Spring

ECD 692 Research Projects in Counselor Education (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

ECD 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECD 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECD 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ECD 699/ECI 699/ELP 699/EMS 699/EOE 699/EAC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECD 731 Career Development Theory and Research (3 credit hours)
Analysis of theory and research in career development and work adjustment as basis for intervention (career counseling, curricular, organizational) as research.

Prerequisite: ECD 524, ELP 532 and PSY 535
Typically offered in Fall and Spring

ECD 732 Advanced Multicultural Counseling (3 credit hours)
Course focuses on the personal and professional development of the students as human beings, global citizens, counselors, and pre-service counselor educators. It is intentionally designed to promote critical self-analysis, cultural understanding, and personal and collective growth and change through honest and respectful discussions, readings, and assignments. The course is grounded in the study of multicultural and counseling theories that emphasize the relevance of social and cultural context and advocacy roles of counselors.

P: ECD 525 or equivalent
Typically offered in Fall only

ECD 735 Counseling Supervision: Theory and Research (3 credit hours)
Examination of conceptual and methodological issues relating to supervision and evaluation of novice counselors. Special emphasis on developmental supervision approaches.

Prerequisite: Doctoral student
Typically offered in Fall only

ECD 736 Advanced Assessment in Counseling (3 credit hours)
Doctoral students will have learning experiences beyond the entry-level master's degree models and methods of assessment. Content focuses on advanced applications of assessment principles in clinical counseling and supervision practice, program evaluation, and outcome and action research studies. Students will demonstrate mastery of foundations of tests and measurement, present advanced assessment content modules during class sessions, and present documented and oral reports on personal quests for advanced knowledge in chosen assessment domains.

Prerequisite: PSY 535 or equivalent
Typically offered in Fall only

ECD 738 Research in Counselor Education (3 credit hours)
Instruction in required skills and knowledge to conduct research in counselor education, including narrative and quantitative integration of research, experimental and quasi-experimental designs, analogue and process research, single subject and descriptive designs, and qualitative research. Preparation of narrative and meta-analytic research review and research proposal with oral presentation.

Prerequisite: Doctoral student : ST 507; PSY 535, Corequisite: ST 508
Typically offered in Spring only

ECD 820 Special Problems In Guidance (1-6 credit hours)
For individual or group studies of one or more of major problems in guidance and personnel work. Problems selected to meet interests of individuals. Workshop procedure used whereby special projects, reports and research developed by individuals and by groups.

Prerequisite: Six hrs. grad. work in dept.
Typically offered in Fall, Spring, and Summer

ECD 843 Advanced Counseling Practicum (4 credit hours)
Participation of doctoral-level students with previous counseling experience in advanced, supervised counseling experience.

Prerequisite: Doctoral student, ECD 642
Typically offered in Fall, Spring, and Summer

ECD 847 Internship in Supervision (4 credit hours)
A supervised internship for doctoral students in assisting with the supervision of first-year students in laboratory and practicum experiences in individual and group counseling and consultation. This is a doctoral-level in-depth internship in the group and individual supervision designed to examine conceptual and methodological issues related to the supervision and evaluation of novice counselors. It is the second part of a two-course sequence devoted to the supervision of counseling. This course has two components: (1) doctoral group supervision sessions, and (2) doctoral individual supervision sessions.

Prerequisite: ECD 735
Typically offered in Spring only

ECD 850 Doctoral Internship (1-9 credit hours)
Utilizing participant-observer role, participation required in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences.

Prerequisite: Nine hrs. in grad. level courses
Typically offered in Fall, Spring, and Summer

ECD 860 Professional Issues In Counseling (1-3 credit hours)
Consideration of contemporary issues, trends and recent research in field of counseling.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECD 886 Internship in Teaching in Counselor Education (4 credit hours)
Using the participant-observer role, this course requires participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing counseling and teaching experiences, identifying critical incidents in counseling and teaching, and predicting consequences of counseling and teaching interventions.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 892 Doctoral Research Projects (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Typically offered in Fall, Spring, and Summer

ECD 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECD 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Crop Science (CS)

CS 101 Field Crop and Turfgrass Management Orientation (1 credit hours)
Introduction to NCSU and the Agricultural Institute with an emphasis on areas related to Field Crops Technology and Turfgrass Management. Students will explore university, college, and departmental resources, academic policies and procedures, career opportunities, and current trends and issues in our related disciplines. Students cannot receive credit for both CS 10 and AGI 10. FCT or TGM only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 111 Field Crop Production (4 credit hours)
Management of field crops, including growth and development, establishment, pest management, environmental considerations, rotations of crops and chemicals, harvesting, storage and marketing. SPEARS

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

CS 116 Agronomic Crops - Cotton, Peanuts, and Tobacco (3 credit hours)
Fundamental agronomic practices associated with the production of cotton, peanuts, and tobacco. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of a quality commodity.

Restriction: AGI Only
Typically offered in Fall and Spring

CS 118 Agronomic Crops - Corn, Small Grains and Soybeans (3 credit hours)
Fundamental agronomic practices associated with the production of corn, small grains and soybean. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of a quality commodity.

Restriction: AGI Only
Typically offered in Fall and Spring

CS 121 Turfgrasses and Their Uses (3 credit hours)
An introduction to turfgrass species and their uses. Emphasis on: size and scope of the turfgrass industry, basic concepts of grass growth and development, characteristics of cool- and warm-season turfgrasses and their use for golf courses, lawns, athletic fields, and other applications. Techniques for successful establishment and maintenance of turfgrass areas.

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 122 Principles of Turfgrass Management (3 credit hours)
An examination of cultural practices essential for management of high quality turfgrass areas. Topics include: function of plant nutrients, fertilizer characteristics and application techniques, irrigation programming, construction of high use turfgrass areas, calibration of spreaders and sprayers, aerification, pesticide fate and developing effective management systems. ERICKSON

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 151 Forage Production (3 credit hours)
Characteristics of major forage crops and their response to agronomic and animal management factors. Utilization methods, growth and quality characteristics related to animal performance. GREEN

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 152 Weed Control in Field Crops (3 credit hours)
Principles involved in development of weed control programs and practical application of weed management techniques for major North Carolina cropping systems. Emphasis on proper use of herbicides. Laboratory includes weed identification and herbicide application methods. JORDAN

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 154/PP 154 Turf Weed and Disease Management (3 credit hours)
General principles in turfgrass weed and disease development and management programs. Different weeds, their life cycles, management techniques, and factors affecting herbicide application performance will be covered. Students will learn the causes, development, identification and management of turfgrass diseases. Laboratory includes weed identification and herbicide application methods. Certain laboratory exercises will require personal transportation to Lake Wheeler Road Turf Field Lab unless otherwise specified by the lab instructors. The course is restricted to AGI students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

CS 155 Advanced Turf Management (3 credit hours)
Turfgrass management covering mineral nutrition, water relations, environmental stress responses and management regimes for low maintenance turf, golf courses, athletic fields and other turf settings.

Requisite: Agricultural Institute Only; Prerequisite: CS 121 and CS 122
Typically offered in Fall only

CS 190 Turf Seminar (1 credit hours)
Discussions of the operations, opportunities, and problems existing in various phases of the turf industry by leaders in the various facets of the industry.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 191 Field Crops Seminar (2 credit hours)
Guest speakers, students presentations, and outside assignments will address professionalism; professional development; and current challenges, issues, and opportunities facing profitable and sustainable agronomic crop production. A grade of C or better is required. FCT Only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

CS 200 Introduction to Turfgrass Management (4 credit hours)
Turfgrass selection, establishment, maintenance, and pest management in lawns, golf courses, athletic fields, and roadside care; Emphasis on understanding the impact of the environment on management practices and turfgrass performance. Field trips in laboratory.

Prerequisite: BIO 181(preferred) or ZO 160(alternate) BO 200, or CS 213
Typically offered in Fall only

CS 210 Lawns and Sports Turf (3 credit hours)
Utilization of turfgrasses for lawns and recreational areas. Emphasis on: the cultural and environmental benefits of grassed areas, concepts of grass growth and development, selecting adapted grasses for proper use, techniques for successful establishment and management of cool-and-warm-season turfgrasses, fertilization, irrigation, aeration, and pest management. The history and benefit of natural and artificial sports fields will also be discussed. Credit will not be awarded for both CS 200 and CS 210.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CS 211 Plant Genetics (3 credit hours)
Fundaments of plant genetics. Genetic basis for plant improvement. Genetic analysis of Mendelian traits, molecular structure and organization of genetic material, crop biotechnology, distribution and behavior of genes in populations.

Prerequisite: BIO 183 or ZO 160
Typically offered in Spring only

CS 213 Crop Science (3 credit hours)
Our basic premise is that to produce field crops successfully we must know how our crops grow and develop and what they require from the production environment - including the farmer - for satisfactory management of the relevant environment, and finally to successful yield and quality of commercially important product. Especially important is to understand the various ways in which producers must respond to ever-changing circumstances on the farm, at the bank (credit), and in the marketplace. A solid understanding of the impact of cropping history on the soil and entire ecosystem to be used for the next crop also is vitally important.

Prerequisite: BIO 181 or BIO 183 or PB 200 or PB 250
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

CS 214 Crop Science Laboratory (1 credit hours)
The laboratory's intent is to provide students enrolled in the CS 213 lecture course opportunity to apply under field and controlled environmental conditions the crop production principles introduced in the lecture course. Using a hands-on approach targeting a variety of crop management approaches, students will examine the growth and development characteristics that relate most directly to final yield and quality of the marketed product. Students will employ a spectrum of treatment combinations aimed at strengthening understanding of the interaction of genotype, environment, and management, with the goal of identifying influential factors of crop yield and quality.

Prerequisite: BIO 181 or BIO 183 or PB 200 or PB 250; Co-requisite: CS 213
Typically offered in Fall and Spring

CS 216 Southern Row Crop Production - Cotton, Peanuts, and Tobacco (3 credit hours)
Crop production systems comprised of cotton, peanuts, and tobacco are unique to the southern United States, and management practices tailored to a successful harvest are vastly different than those employed in the production of grain crops. CS 216 will introduce students to these production standards and provide a basic foundation for the principles of cotton, peanut, and tobacco management. At the conclusion of the course students will be able to describe growth/development patterns, tillage systems, scouting techniques, proper seed/variety selection and planting populations, provide recommendations for pest management, employ Integrated Pest Management strategies, describe harvesting practices, and give marketing approaches for each crop.

Typically offered in Fall and Spring

CS 218 Southern Row Crop Production - Corn, Small Grains and Soybeans (3 credit hours)
Fundamental agronomic practices associated with the production of corn, small grains and soybean. Discussions will include crop growth and development stages, how to choose the best varieties and hybrids, planting strategies, fertility and pest management programs, harvest and storage options, and the use of technologies associated with the production and maintenance of quality commodity.

Typically offered in Fall and Spring

CS 224 Seeds, Biotechnology and Societies (3 credit hours)
An exploration of seeds, how seeds are the delivery system for crop biotechnology and how a specific culture's perception of science and agriculture influence the acceptance or rejections of modern genetic technologies. Topics include seed germination, survival and preservation; seed industry influence on societies and how societies are influencing the seed industry; seed production - commercially and at home; how our diverse genetic resources are preserved; how biotechnology is applied to agriculture and delivered through seeds; the impact biotech is having on the seed industry and subsequently on us and global agriculture; concerns and potential benefits of biotechnology application to crops.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

CS 230 Introduction to Agroecology (3 credit hours)
This course will examine the biological and physical attributes of farming systems and their associated ecological and social impacts in temperate and tropical regions. It will address the ecological consequences of indigenous food and fiber production systems, conventional agricultural systems and "alternative" systems that incorporate biological pest control and natural nutrient inputs. Students will examine several case studies that integrate their understanding of concepts.

Prerequisite: BIO 105 or BIO 181 or BIO/ZO 160 or BO 200 or BO 250 or HS 201 or CS 213
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

CS 251 Production of Forage Crops (3 credit hours)
Basic principles and practices of production and utilization of pasture and forage crops; impact on developing sustainable systems for livestock feed, soil and water conservation; use of computers to assist in whole farm planning and information retrieval.

Prerequisite: CS 213 and SSC 200
Typically offered in Spring only

CS 400 Turf Cultural Systems (3 credit hours)
Topics include: golf course design considerations, fertilizer characteristics and application techniques, irrigation programming, construction of high use turfgrass areas, calibration of spreaders and sprayers, aerification, pesticide fate and development of effective management systems.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

CS 410/HS 410 Community Food Systems (3 credit hours)
This course explores the economic, socio-cultural, policy and health perspectives of community food systems using a multidisciplinary and systems-level framework. Students will use a systems framework to critically examine local and global food challenges related to food insecurity, food justice and food sovereignty, food waste and sustainable approaches to addressing food challenges. Novel aspects of this course include student experiential learning opportunities that include service learning with community partners addressing local food challenges, team building through group work and in-class discussion and development of personal food ethic provocative proposition.

Prerequisite:Junior or senior standing
Typically offered in Fall only

CS 411 Crop Ecology (3 credit hours)
Ecology and production of major agronomic crops of economic importance. Impact of key environmental stress factors on production processes and management strategies. Environmental issues pertaining to sustainable cropping systems. Manipulation of canopy climate and rooting environment for enhanced crop performance in the context of global climate change. Ecological analysis of abiotic - and biotic-derived crop disorders.

Prerequisite: PB 321 or PB 421
Typically offered in Fall only

CS 413 Plant Breeding (3 credit hours)
Focuses on principles of cultivar development for a diversity of plant species using conventional breeding and selection methodologies, DNA markers, de novo genetic variation, and biotechnological approaches.

Prerequisite: CS 211 or GN 311
Typically offered in Spring only

CS 414 Weed Science (4 credit hours)
History, current status and fundamentals of weed biology and cultural, biological, and chemical weed control; properties and uses of herbicides; weed identification; proper use of herbicide application equipment; current weed management practices incrops and non-cropland situations.

Typically offered in Fall only

CS 415 Integrated Pest Management (3 credit hours)
History, principles, and application of techniques for managing plant pests. Theory and practice of integrating pest control tactics to manage pests within economic, environmental, and sociological constraints. Topics include pest monitoring methodology, economic aesthetic thresholds, biological control, efficient pesticide use, biotechnology, and global positioning systems.

Prerequisite: BIO 181(preferred) or ZO 160(alternate) or BO 200 or BO 250
Typically offered in Spring only

CS 418/CS 518 Introduction to Regulatory Science in Agriculture (3 credit hours)
This course covers laws, regulations and agencies involved in the registration of conventional, biotechnology and biological crops, crop protectants and growth regulators. US and International laws and regulations will be discussed from technical proof of concept through commercial release.

Typically offered in Fall only

CS 424/CS 524 Seed Physiology (3 credit hours)
This course will explore the physiological processes associated with seed formation, development, maturation, germination, and deterioration of agronomic and horticultural species. We will also study the physiological aspects of seed dormancy, how dormancy is manifested and overcome in cultivated and noncultivated systems and dormancy's impact on weed seedbank ecology.

Prerequisite: PB 321 or PB 421 or FOR 303
Typically offered in Fall only

CS 428/CS 528 Advanced Regulatory Science in Agriculture (3 credit hours)
This course goes into additional depth and provides hands-on exercises concerning agriculture regulatory topics covered in CS 418/518. The course will introduce laws, regulations and agencies involved in the fertilizer, animal and waste management as well as the role of public policy in the regulatory process. CS 418/518 is a prerequisite for this class.

Prerequisite: CS 418
Typically offered in Spring only

CS 430/CS 530 Advanced Agroecology (4 credit hours)
This course applies agroecological principles and critical thinking to evaluate various agroecosystems. Students will examine food, fiber, and other commodity production systems for security, productivity, and sustainability and address the simultaneous need to protect natural environments and the biodiversity on which agroecosystems depend. Topics include discussion of national and international government policies, research programs, and education programs that influence the future application of agroecosystem principles.

P: CS 230
Typically offered in Spring only

CS 465/CS 565 Turf Management Systems and Environmental Quality (3 credit hours)
Integration of turfgrass management systems and the use of BMPs and IPM to protect environmental quality. Examination of water quality issues relative to turf. Application of Best Management Practice and Integrated Pest Management strategies. Credit cannot be received for both CS 465 and CS 565. Senior standing.

Prerequisite: CS 400 and Senior standing
Typically offered in Fall only

CS 470/ENT 470/PP 470 Advanced Turfgrass Pest Management (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pestmanagement programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

CS 480/HS 480 Sustainable Food Production (capstone) (1 credit hours)
This course introduces students to the process of developing a project for presentation in the area of sustainable food production and food systems. Students are to synthesize and integrate knowledge acquired in previous course work and other learning experiences and to apply theory and principles in a situation that approximates some aspect of professional practice. Students are expected to present their projects at the end of the semester in a PowerPoint style format to faculty and student peers.

Prerequisites: Senior standing and CS 430
Typically offered in Fall and Spring

CS 502/HS 502/PP 502 Plant Disease: Methods & Diagnosis (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips arerequired.

Prerequisite: PP 315
Typically offered in Fall only

CS 518/CS 418 Introduction to Regulatory Science in Agriculture (3 credit hours)
This course covers laws, regulations and agencies involved in the registration of conventional, biotechnology and biological crops, crop protectants and growth regulators. US and International laws and regulations will be discussed from technical proof of concept through commercial release.

Typically offered in Fall only

CS 524/CS 424 Seed Physiology (3 credit hours)
This course will explore the physiological processes associated with seed formation, development, maturation, germination, and deterioration of agronomic and horticultural species. We will also study the physiological aspects of seed dormancy, how dormancy is manifested and overcome in cultivated and noncultivated systems and dormancy's impact on weed seedbank ecology.

Prerequisite: PB 321 or PB 421 or FOR 303
Typically offered in Fall only

CS 528/CS 428 Advanced Regulatory Science in Agriculture (3 credit hours)
This course goes into additional depth and provides hands-on exercises concerning agriculture regulatory topics covered in CS 418/518. The course will introduce laws, regulations and agencies involved in the fertilizer, animal and waste management as well as the role of public policy in the regulatory process. CS 418/518 is a prerequisite for this class.

Prerequisite: CS 418
Typically offered in Spring only

CS 530/CS 430 Advanced Agroecology (4 credit hours)
This course applies agroecological principles and critical thinking to evaluate various agroecosystems. Students will examine food, fiber, and other commodity production systems for security, productivity, and sustainability and address the simultaneous need to protect natural environments and the biodiversity on which agroecosystems depend. Topics include discussion of national and international government policies, research programs, and education programs that influence the future application of agroecosystem principles.

P: CS 230
Typically offered in Spring only

CS 535/SSC 535 Root and Rhizosphere Processes for Plant Nutrition (3 credit hours)
The focus of this course is on the understanding of concepts and principles of plant hydro-mineral acquisition, plant adaptation to nutrient deficiencies, water and nutrient cycles in the soil, and the impact that microbial communities have on these processes. Understanding below ground biological networks and their complexity is crucial for understanding soil fertility and improving the acquisition of nutrients in natural and agroecosystems.

Prerequisite: SSC 200 or PB 321, or consent of instructor
Typically offered in Fall only

CS 541/HS 541 Plant Breeding Methods (3 credit hours)
Overview of plant breeding methods for advanced undergraduate and beginning graduate students. Covers principles and concepts of inheritance, germplasm resources, pollen control, measurement of genetic variances, and heterosis. Special topics include heritability, genotype-environment interaction, disease resistance, and polyploidy. In-depth coverage on methods for breeding cross-pollinated and self-pollinated crops. Prepares students for advanced plant breeding courses.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Fall only

CS 565/CS 465 Turf Management Systems and Environmental Quality (3 credit hours)
Integration of turfgrass management systems and the use of BMPs and IPM to protect environmental quality. Examination of water quality issues relative to turf. Application of Best Management Practice and Integrated Pest Management strategies. Credit cannot be received for both CS 465 and CS 565. Senior standing.

Prerequisite: CS 400 and Senior standing
Typically offered in Fall only

CS 590 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in crop science and related fields.

CS 591 Special Problems (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.

CS 601 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports in research and special problems of interest to agronomists. Maximum of two credits allowed toward master's degree; however, additional credits toward doctorate allowed.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

CS 620 Special Problems (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

CS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

CS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

CS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

CS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

CS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

CS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

CS 701 Breeding for Insect Resistance and Abiotic Stress (2 credit hours)
This course will cover the basic principles of breeding for insect resistance and abiotic stress. Topics include plant defenses, interactions between pest or stress and plant and environment, types of resistance, methods of breeding and screening.

Prerequisite: CS 413, CS 541, or GN 311; Students who believe to have acquired a similar background through different courses should contact the instructor or the director of the program.
Typically offered in Fall only

CS 714 Crop Physiology: Plant Response to Environment (3 credit hours)
Examines interactions between plants and the environment. Light environment, plant canopy development, photosynthesis, source-sink relations, growth analysis, growth regulation, water relations, and environmental stresses are addressed.

Prerequisite: (PB 321 or PB 421) and CH 223 or CH 227
Typically offered in Fall only

CS 716/HS 716 Weed Biology (3 credit hours)
This course analyzes the interactions between human disturbance and dynamics of weed populations and communities. Emphasis is given to factors that drive weed control actions and the ecological and evolutionary processes by which weeds survive and adapt to these actions. Similarities and differences between weeds and invasive plant species are discussed as well as benefits and limitations of using traditional ecological theory from natural systems to explain weed behavior in highly disturbed environments.

Prerequisite: CS 414
Typically offered in Spring only

CS 717/HS 717 Weed Management Systems (1 credit hours)
Weed management systems including integration of cultural, biological, mechanical and chemical methods for vegetables, fruits, ornamentals, turf, small grains, corn, tobacco, cotton, peanuts, aquatic and non-cropland settings. Taught second 5 weeksof semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 414
Typically offered in Fall only

CS 720/GN 720/HS 720 Molecular Biology In Plant Breeding (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Understanding of the relationship between genes and crop traits. Principles and molecular mechanisms of crop traits, and their applications to solve breeding problems and improve crop traits, which include heterosis, male/female sterility, self-incompatibility, polyploidy, double haploid, protoplast fusion, random mutagenesis, plant regeneration, transgenic breeding, advanced genome editing for breeding, gene silencing, gene activation, gene drive, plant synthetic biology, metabolic engineering, epigenetics for trait improvement, gene stacking, decoy and R genes, and bioconfinement.

P: CS 211 or GN 311 or equivalent, and PB 421 or equivalent.
Typically offered in Spring only

CS 725/HS 725/SSC 725/TOX 725 Pesticide Chemistry (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taughtduring the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Fall only

CS 726/ANS 726/FOR 726 Advanced Topics In Quantitative Genetics and Breeding (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Fall only

CS 727/HS 727/SSC 727/TOX 727 Pesticide Behavior and Fate In the Environment (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725,SSC 200
Typically offered in Fall only

CS 729/HS 729 Herbicide Behavior In Plants (2 credit hours)
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

Prerequisite: BO 751 and BO 752 and CS(HS,SSC) 725
Typically offered in Spring only

CS 745/GN 745/HS 745 Quantitative Genetics In Plant Breeding (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.

Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

CS 746/GN 746/HS 746 Cytogenetics in Plant Breeding (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

Typically offered in Spring only

CS 755 Applied Research Methods and Analysis for Plant Sciences (3 credit hours)
Students will gain understanding of the common principles of scientific method. They will gain knowledge and experience with planning for research, developing research objectives, methodology considerations, experimental design, statistical analyses, and presentation of data. Class will have a heavy focus on experimental methods in applied plant science research.

Prerequisite: ST 511
Typically offered in Fall only

CS 795 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in crop science and related fields.

CS 801 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports in research and special problems of interest to agronomists. Maximum of two credits allowed toward master's degree; however, additional credits toward doctorate allowed.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

CS 820 Special Problems (1-6 credit hours)
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis on review of recent and current research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

CS 860/GN 860/HS 860 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Spring only

CS 861/GN 861/HS 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Fall only

CS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

CS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Spring and Summer

CS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Spring only

CS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

CS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

CS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Curriculum and Instruction (ECI)

ECI 201 Intro to Instructional Technology for Educators (3 credit hours)
Introduction to effective technology integration in teaching practices across the curriculum for pre-service teachers. Exploration of different technology-based tools commonly integrated in instruction, including desktop, Internet/ Web-based, mobile, and cloud applications. Examination of integration challenges using relevant, real-world examples from current teacher practices. Planning for student-centered, project-based lessons that make use of diverse technologies.

Typically offered in Fall and Spring

ECI 204 Intro to Teaching (1-2 credit hours)
For prospective teachers in Middle and Secondary Business and Marketing, English, Foreign Languages, Language Arts, and Social Studies. Emphasis on what it means to be an educator as well as differing aspects and procedures of instruction and analysis of competencies required of teachers. The course has a required fieldwork component in local K-12 school, and students are responsible for their own transportation to and from the schools. students are required to puchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.

Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Fall and Spring

ECI 205 Introduction to Teaching Humanities and Social Sciences (3 credit hours)
For prospective teachers in secondary and middle years social studies, English, language arts, and foreign languages. An emphasis on differing aspects and procedures of instruction and analysis of competencies required of teachers. Field work in avariety of education settings including an extended period in one curriculum area.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ECI 296/ED 296 Special Topics in Education (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall and Spring

ECI 305 Equity and Education (3 credit hours)
This course examines the intersection of diversity, inclusivity, equity, and P-16 education; specifically by considering multiple identity markers such as: gender, sexuality, race, socioeconomic status, ability, and all aspects of culture. This interdisciplinary course uses a sociological lens to examine educational materials, research studies, memoirs, and media to explore the following essential questions: In what ways do students' cultural identities impact their experiences in schools?; How are social inequalities perpetuated by and within the educational system?; What types of individual and systemic practices can help disrupt the marginalization of students in P-16 schools? How can schools celebrate and sustain students' cultural identities?

Prerequisite: ED 204 or AEE 206 or ELM 250 or Junior Status
GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

ECI 306 Middle Years Reading (3 credit hours)
Reading skills in middle years education developed with emphasis on application of the reading process to content area.

Prerequisite: Six hours in ED or PSY
Typically offered in Spring only

ECI 307 Teaching Writing Across the Curriculum (3 credit hours)
For prospective teachers of all disciplines in middle/high school. Practical strategies for writing as a learning tool and for teaching writing. Lesson plans, assignments, experiences appropriate to content areas. Focus on writing, writing instruction, and technology. Separate sections for Middle Grades (MSL) and English (LTN) majors.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ECI 309 Teaching in the Middle Years (3 credit hours)
Nature and purposes of middle grades education. Early adolescent development, curriculum, teaching/learning methods, school organization, and characteristics of effective middle years teachers. Includes field experience.

Prerequisite: Six hours in ED or PSY
Typically offered in Fall and Spring

ECI 332 Health Promotion and Disease Prevention (3 credit hours)
Emphasis on education of the public regarding general health concerns including cancer, cardiovascular disease, accident prevention, nutrition, drugs, alcohol, mental health, sexuality, and environmental hazards.

Prerequisite: For credentialed health professionals only
Typically offered in Spring only

ECI 333 Health Care Delivery (3 credit hours)
The historical basis of health care delivery in the U. S. with emphasis on hospitals, health maintenance organizations, ambulatory care centers, ambulatory surgery, nursing homes, and private care practice. Philosophical issues of funding health care, promoting health care, and the training of health care workers.

ECI 335 Planning Classroom and Clinical Curricula (3 credit hours)
Procedures for planning health occupations curricula for classroom and clinical settings. Practice in writing, updating, and refining health curriculum with emphasis on selection and sequencing. Comparison of styles of writing curricula. Roles and responsibilities of healthy curriculum planner.

Prerequisite: For Certification Majors: EOE 101, 205 ; For Non-Certification Majors: EOE 101. For credentialed health professionals

ECI 336 Strategies for Teaching a Health Occupations Course (3 credit hours)
Planning and implementation of effective instructional strategies for clinical and classroom settings. The nature of the teaching/learning process, psychological and philosophical aspects of teacher choice of various strategies.

Prerequisite: For credentialed health professionals
Typically offered in Spring only

ECI 405/ENG 405 Literature for Adolescents (3 credit hours)
The history, types, and characteristics of literature for adolescents. Emphasizes reading and analyzing the literature by exploring the themes, literary elements, and rationale for teaching literature for adolescents. Addresses ways in which this literature can be integrated and implemented in English/Language Arts curriculum.

Prerequisite: Junior standing.
Typically offered in Fall only

ECI 414 Human Relations and Discipline in the Classroom (3 credit hours)
Designed to help prospective teachers foster positive interpersonal relationships in classrooms, build a sense of community and create a purposive environment for learning. Investigates issues such as group building, active listening, and major approaches to discipline. Uses case studies and problem solving methods.

Prerequisite: PSY 304 or EDP 304 and 6 hours of education

ECI 416 Teaching Exceptional Students in the Mainstreamed Classroom (3 credit hours)
Provides classroom teachers in all disciplines and grade levels with a knowledge of various handicapping conditions, as well as with techniques to assist exceptional students within the mainstreamed classroom. Required for MSL majors.

Prerequisite: Six hours in ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 423 Methods for Teaching Modern Foreign Languages K-12 (5 credit hours)
Methodology and pedagogy of teaching Foreign Languages grades K-12 with an emphasis on lesson and unit planning, second language acquisition, diversity, national and state standards, materials, assessment, proficiency oriented teaching, and demonstrations/practice teaching in micro-lessons. This course provides opportunities for prospective Foreign Language teachers to integrate knowledge of their language with effective materials, strategies, and methods of instruction to prepare students for K-12 Foreign Language teaching. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools.

Restriction: Open to FLL Education majors or by permission
Typically offered in Fall only

ECI 424 Student Teaching in Modern Foreign Languages (12 credit hours)
Teaching experience for prospective teachers of Modern Foreign Languages in a selected elementary, middle or high school under the supervision of a cooperating teacher and a university faculty supervisor. Additional school observations and on campus seminars are a part of this course. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are covered under the General Statute affording liability protection.

Prerequisite: Admission to Professional semester, ECI 423
Typically offered in Spring only

ECI 427/ECI 527/FL 527/FL 427 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.

Typically offered in Fall and Spring

ECI 430 Methods and Materials for Teaching Language Arts in the Middle Grades (4 credit hours)
Inquiry, activity-oriented course provides opportunities for prospective language arts middle school teachers to integrate knowledge of English with effective materials, strategies, methods of instruction. Students observe middle school classes, plan lessons, and units, practice varied classroom strategies, technologies in micro-lessons. Prepared students for teaching language arts with other content areas in middle schools.

Prerequisite: ECI 205,ELP 344,PSY 304 or EDP 304,ECI 309, ECI 306, ECI 307, Senior standing, candidacy in Middle Grades Teacher Education, Corequisite: ECI 435
Typically offered in Fall only

ECI 435 Methods and Materials for Teaching Social Studies in the Middle Grades (4 credit hours)
For preservice middle school social studies teachers. Focus on: teaching and evaluation skills, adaptation of instruction to individual learner differences, identification and creation of instructional materials appropriate for use in social studies teaching.

Prerequisite: Admission to professional semester
Typically offered in Fall only

ECI 436/FL 536/ECI 536/FL 436 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.

GEP U.S. Diversity
Typically offered in Fall and Spring

ECI 438 Medical Law and Ethics (3 credit hours)
Ethical and legal issues involved in delivering health care, such as euthanasia, reproductive technology, organ transplants, patients' rights, and confidentiality. Classical ethical theories and principles. Systematic review procedures and currentmedical law used to examine current case dilemmas in the health professions.

Typically offered in Fall only

ECI 442 Field Experience in Business and Marketing Education (3 credit hours)
Supervised off-campus work experience in an approved business and marketing content related job. The work experience relates on-the-job experiences to the technical competencies taught in the North Carolina Standard Course of Study for business and marketing education. Students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.

Prerequisite: Junior standing
Typically offered in Fall and Summer

ECI 444 Administration of Business and Marketing Education (3 credit hours)
Development of successful business and information technology, and marketing education programs. Program promotion, managing cooperative education experiences, managing DECA and FBLA chapters, and determining professional development strategies. Primary roles of the business and information technology and marketing education teachers' classroom instruction. Program management, classroom management, management of career-technical student organizations, cooperative education, and program development.

Prerequisite: ED 204 and ECI 204 and MKE Business and Marketing Education Major
Typically offered in Fall only

ECI 445 New Literacies, Emerging Technologies, and Electronic Portfolios (2 credit hours)
Inquiry, activity-oriented course designed to engage students in theory and practice related to 21st century skills, new literacies, and emerging technologies, as well as focused support for developing the culminating electronic portfolio. Course provides opportunity for pre-service, English Language Arts/ Social Studies middle School teachers to integrate knowledge of English and Social Studies with emerging technologies and digital literacy applications.

Prerequisite: Senior Standing; Corequisite: ECI 430 and ECI 435
Typically offered in Fall only

ECI 446 Curriculum and Methods of Teaching Business and Marketing Education (4 credit hours)
Study of the curriculum common to business and information technology and marketing education and the research behind its development. Methods common to instructional planning, implementation, and evaluation of effective business and information technology and marketing education programs are topics included in this course. Twenty hours of field work are required. Student are expected to provide their own transportation to and from assigned public schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details in acquiring the insurance and the current charge. MKE students only.

Prerequisite: Admission to Teacher Education Candidacy ; MKE Business and Marketing Education Majors
Typically offered in Fall only

ECI 447 Student Teaching in Business and Marketing Education (9 credit hours)
Fifteen weeks full-time student teaching business and marketing subjects in the public schools under the supervision of a cooperating teacher and university supervisor. Students will develop skills in instruction, evaluation, advisement, administration, and observation. Students are expected to provide their own transportation to and from assigned public schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. MKE students only.

Prerequisite: Admission to Professional Semester ; MKE Business and Marketing Education Majors, Corequisite: ECI 494
Typically offered in Spring only

ECI 448/ECI 548 E-Business Applications in Business and Marketing Education (3 credit hours)
Emphasis on design and construction of advanced web pages, business and marketing applications of electronic commerce, as well as economic, social, legal, and ethical issues that are related to conducting business in a virtual environment. Content prepares students to apply principles to the business and marketing education curriculum in the public schools. Credit for both ECI 448 and ECI 548 is not allowed.

Typically offered in Fall only

ECI 449 MSL Senior Student Teaching Seminar (2 credit hours)
ECI 449 is the senior seminar held in conjunction with MSL Student Teaching Internship experiences, ECI 454 and ECI 464, which provide the prospective teacher with experience in the techniques and skills involved in teaching middle grades English Language Arts and/or Social Studies, including 16 weeks in a selected off-campus placement. Student teachers become familiar with the total school program and participate in selected school and community activities while meeting internship and program requirements. The seminar provides an opportunity for students to process and analyze the internship experience with the support of their cohort, university supervisor, instructor, and local school personnel with expertise in middle grades teaching and related topics.

C: Seminar is for MSL senior student teachers enrolled in ECI 454 and ECI 464.
Typically offered in Spring only

ECI 450 Methods and Materials in Teaching English (4 credit hours)
Methods and materials of teaching English in grades 9-12, with an emphasis on lesson planning and demonstrations/practice in teaching literature, study skills, speaking, listening, and writing. Taught during the first seven weeks of the semester.

Prerequisite: ECI 204, ELP 344, PSY 304 or EDP 304; Senior standing and admission to Teacher Education candidacy with a Major in English
Typically offered in Spring only

ECI 451 Teaching Reading Across Disciplines (3 credit hours)
Facilitates study of methods and materials for teaching literacy across disciplines. Develops instructional strategies in the use of print and digital texts and media to support disciplinary learning.

Prerequisite: Six hours in ED or PSY
Typically offered in Fall and Spring

ECI 454 Student Teaching in English/Language Arts (1-12 credit hours)
Provides the prospective teacher with experience in the techniques and skills involved in teaching English in secondary schools or Language Arts in middle schools in a selected off-campus station. Student interns become familiar with the total school program, eventually carrying a full teaching load, and participate in relevant school and community activities. Students are required to provide their own transportation. TED and MSL majors only.

Prerequisite: For TED & MSL students: Admission to Student Teaching Professional Semester; Also for MSL students: ECI 430, ECI 416; Co-requisite: TED students: ECI 450; MSL students: ECI 464 and ECI 449
Typically offered in Spring only

ECI 460 Methods and Materials in Teaching Secondary Social Studies (4 credit hours)
Teaching techniques, innovations, and development of teaching and evaluation skills in the area of secondary school social studies. Adaptation of instruction to individual learner differences, and selection and design of instructional materials. Taught during the first six weeks of the semester. Taught during the first six weeks of the semester.

Prerequisite: ECI 205, ELP 344, Sr. standing and admission to professional semester with a major in either history, sociology, political science
Typically offered in Fall only

ECI 464 Student Teaching in Social Studies (5 credit hours)
Skills and techniques in teaching social studies in secondary and middle schools. Each student spends sixteen weeks in a selected off-campus center. The student demonstrates competencies essential for teaching social studies, becomes familiar with the total school program, and participates in a variety of school and community activities.

Prerequisite: Admission to professional semester, Corequisite: For LTH, LTP, LTS students: ECI 460. For MSL students: ECI 454, ECI 449
Typically offered in Spring only

ECI 471 Educational Implications of Learning and Developmental Theory (3 credit hours)
Topics related to human psychological development. Cognitive, social, physical changes, and their interaction among adolescence. Departmental Approval Required.

Prerequisite: NC TEACH Participants
Typically offered in Spring and Summer

ECI 472 Interaction of Classroom Management and Instruction (3 credit hours)
Topics related to teaching in the content area and classroom management. Lesson planning, principles applied to education, measurement and evaluation procedures, behavior therapy, and student motivation. Departmental Approval Required.

Prerequisite: ECI 471 ; NC TEACH Participants
Typically offered in Spring and Summer

ECI 473 Subject Specific Methods (3 credit hours)
Topics related to cultural factors and how they affect teachers and students in the classroom. Instructional techniques and the development of instructional plans that enhance schooling experiences of culturally diverse students. Departmental Approval Required.

Prerequisite: ECI 472 ; NC TEACH Participants, Corequisite: ECI 474
Typically offered in Fall only

ECI 474 Curriculum and Instruction Practices 1 (3 credit hours)
Topics related to essential skills and concepts needed by beginning teachers. The class focuses on questioning, test preparation, discussion skills, familiarity with national standards, multiple teaching strategies, and assessment + evaluation of students. Departmental Approval Required.

Prerequisite: ECI 472 ; NC TEACH participants, Corequisite: ECI 473
Typically offered in Fall only

ECI 475 Peer Mentoring in Alternative Licensure (3 credit hours)
Topics related to observing and evaluating fellow teachers in relation to the national state teaching competencies. Classroom observations, videotaping, and group evaluations that are shared and discussed with fellow teachers. Departmental Approval Required.

Prerequisite: ECI 474 ; NC TEACH Participants, Corequisite: ECI 476
Typically offered in Spring only

ECI 476 Curriculum and Instruction Practices 2 (3 credit hours)
Topics related to inquiry, activity based instruction, and constructivist principles. Analysis of principles, strategies and application of new teaching approaches. Departmental Approval Required.

Prerequisite: ECE 474 ; NC TEACH Participants, Corequisite: ECI 475
Typically offered in Spring only

ECI 494 Senior Seminar in Business and Marketing Education (3 credit hours)
Discussion and analysis of problems, trends, and issues experienced while student teaching in the public schools.

Prerequisite: Admission to Professional Semester ; MKE Business and Marketing Education Majors, Corequisite: ECI 447
Typically offered in Spring only

ECI 496/ED 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior standing or Senior standing
Typically offered in Fall and Spring

ECI 500 Theory and Practice In Teaching Diverse Populations (3 credit hours)
Analysis of literature and research in related to impact of cultural factors on teaching and learning in contemporary schools. Exploration of teaching techniques and curricular directions designed to improve school experiences for diverse populations in K-12 settings.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ECI 501 Foundations of Curriculum (3 credit hours)
Origin, development, and current status of elementary and secondary school curriculum and an evaluation of trends and issues likely to influence the curriculum in the future.

Prerequisite: 12 sem. hrs. graduate ED and PSY
Typically offered in Summer only

ECI 502 Technology Program Evaluation (3 credit hours)
This course is about evaluation of instructional technology programs, which is the systematic process of collecting and analyzing data in order to determine whether and to what degree program goals have been or are being achieved.

Prerequisite: Graduate Standing
Typically offered in Fall and Spring

ECI 505/FL 505 Issues and Trends in Foreign Language Education: Theory & Practice (3 credit hours)
An exploration of theory and practice issues related to foreign language teaching. Inquiry into proficiency-oriented instruction, innovative methodological approaches, the National Standards and learning scenarios, integrating culture, options for testing and assessment, content-based instruction, the role of grammar in second language acquisition, teaching foreign language students with learning disabilities, and Foreign Language in the Elementary School (FLES) in North Carolina. Students will examine case studies related to these topics and engage in a classroom action research project.

Prerequisite: Graduate standing
Typically offered in Fall and Summer

ECI 507 Social Justice Education (3 credit hours)
Introduction to principles of social justice education and their centrality in progressive policies and pedagogies that lead to equity in all teaching contexts. Students will develop strategies for successfully incorporating a social justice education framework in scholarship and professional practice.

Prerequisite: ECI 500
Typically offered in Fall only

ECI 508 Teachers as Leaders (3 credit hours)
Examines teacher leadership research, theory, and practice. Prepares teachers to assume leadership roles in classrooms, schools, school systems, and the larger educational community. Independent research projects required.

Prerequisite: Graduate standing
Typically offered in Spring only

ECI 509 Special Problems in Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 510 Research Applications In Curriculum and Instruction (3 credit hours)
Focus on current issues and research methods used in the areas of curriculum development and supervision, instructional technology, English education, middle grades education, reading education, social studies education and special education.

Prerequisite: ST 507, Doctoral student, C and I Major
Typically offered in Spring and Summer

ECI 511 Introduction to Learning Design and Technology (3 credit hours)
Introduction to the Learning, Design, and Technology master's program at North Carolina State University and to the field of instructional design and educational technology, with an investigation of relevant careers, important theories and models guiding practice, and noteworthy research findings by area.

Restriction: Graduate Standing
Typically offered in Fall and Summer

ECI 512 Emerging Technologies for Teaching and Learning (3 credit hours)
Examination of emerging technologies as applied in educational settings with a focus on related research, case studies, theoretical underpinnings, and strategies for effective integration.

Typically offered in Spring and Summer

ECI 513 Teaching and Learning with Digital Video (3 credit hours)
Development and implementation of digital video within educational contexts and situations. Design of educational watching, analyzing, and creating activities with video. Application of conventions and genres of digital video capture and editing to sample technology projects across curricular areas.

Prerequisite: Graduate standing
Typically offered in Summer only

ECI 514 Developing and Delivering Online Instruction (3 credit hours)
Examination of learning theories and research-based principles to design and apply appropriate digital tools to create maximally effective educational products.

Prerequisite: Graduate Standing
Typically offered in Spring only

ECI 515 Cultural Investigations and Technical Representations in Education (3 credit hours)
Examination of contemporary approaches that educators can use to help their students construct cultural understanding in education settings through investigations and technical representations of culture with emerging tools (e.g., mapped cultural tours, AR/VR heritage exhibition, documentary, social media, games, fabrication, data analytics and visualization).

Typically offered in Fall only

ECI 516 Design and Evaluation Of Instructional Materials (3 credit hours)
Characteristics and selection of various media for instruction and their use in educational settings. Design and production of instructional materials. Analysis of research in the field. Individualized projects and assignments. Application of grounded research and theory concerning learning to design of instructional materials. Structured projects and practical experiences used to transfer design principles and evaluate instructional products.

Prerequisite: Graduate standing
Typically offered in Spring only

ECI 517 Theoretical Foundations of Advanced Learning Environments (3 credit hours)
Examination and application of behavioral, cognitive, and constructivist theoretical frameworks underlying the design and development of advanced technology-enhanced learning environments.

Typically offered in Fall only

ECI 518 Digital Learning Program and Staff Development (3 credit hours)
Study and application of principles related to digital learning program planning, facilities and resource management, and staff development in K-12 settings.

Prerequisite: ECI 511, ECI 514, ECI 515, ECI 642
Typically offered in Spring only

ECI 519 Special Problems in Learning Design and Technology (3 credit hours)
In-depth study of topical problems in Learning Design and Technology selected from areas of current concern to practitioners in education.

Typically offered in Fall, Spring, and Summer

ECI 520 The Teaching Of Composition (3 credit hours)
For classroom teachers. Practical field-tested ideas to help students improve as writers by focusing on composition as a process as well as a product. Activities for teaching prewriting, drafting, revising, proofreading, grammar and evaluating with suggestions for individual and group learning. Writing in content areas and composition research/ theory. To take this course in sum. as part of Capital Area Writing Project, student must apply and be selected

Prerequisite: 9 hrs. of ED, PSY and/or ENG;
Typically offered in Spring only

ECI 521 Teaching Literature For Young Adults (3 credit hours)
Designed to acquaint in-service and pre-service teachers with breadth and diversity of contemporary literature for adolescents, with emphasis on teaching young adult literature. Addresses history and themes of young adult literature, readability of materials, reading preferences, literary merit, skills that can be taught through literature, censorship, motivating students to read and organizing literature units.

Prerequisite: Senior standing or Graduate standing or PBS status
Typically offered in Fall only

ECI 522 Trends and Issues in English Language Arts Education (3 credit hours)
Consideration of past, current, and future trends and issues in English Language arts instruction, standards, and methodologies. Examination of research, theory, and practice in concert with trends, issues, and questions. Independent research projects required.

Prerequisite: Graduate standing

ECI 523 Teacher as Researcher (3 credit hours)
This course is designed to introduce the methods and skills required for designing, conducting, interpreting, and applying action research - the systematic inquiry into curriculum, instruction, teaching, and learning. This course will focus on reflective inquiry and practical applications.

Prerequisite: Graduate standing
Typically offered in Summer only

ECI 524 Theory and Research in Global Learning (3 credit hours)
An examination of theoretical frameworks for global learning and comparative studies of various national approaches to K-12 education. This course provides students with multiple lenses through which to consider how we teach and learn given the demands and opportunities present in our interconnected world.

Typically offered in Spring and Summer

ECI 525 Contemporary Approaches In the Teaching Of Social Studies (3 credit hours)
Analysis of principles, strategies and application of new teaching approaches. Structured projects and practical experiences.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall only

ECI 526 Theory and Research On Teaching and Learning Social Studies (3 credit hours)
A critical analysis of the literature relating to the teaching and learning of social studies and the drawing of implications for instructional practices.

Prerequisite: ECI 530 or ECI 525
Typically offered in Summer only

ECI 527/FL 527/FL 427/ECI 427 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ ECI 527.

Typically offered in Fall and Spring

ECI 528 Strategies for Teaching English in Secondary Schools (3 credit hours)
Methods and materials of teaching English in grades 9-12, with and emphasis on lesson planning and demonstrations/practice in teaching literature, study skills, speaking, listening, media literacy, and writing. Some classes and assignments will be completed in a field setting.

Typically offered in Fall only

ECI 530 Social Studies In the Elementary School (3 credit hours)
Advanced professional training in teaching of social studies for middle grades and elementary teachers, including in-depth introduction to research-based teaching strategies, instructional resources and literature of the field.

Prerequisite: Six hrs. in ECI

ECI 531 Advanced Writing in Education (3 credit hours)
Appropriate for any specialty area in Education. Focus on writing required in graduate courses, research reviews for educational reports and National Board Certification, writing for educational journals, theses, and dissertations. Opportunities to gain knowledge, tools, and strategies to meet the academic community's standards. Strategies to develop and/or enhance form, style, content, quality of academic writing, and on researching, composing, revising, and editing. Students will compose,self-evaluate and give feedback on the work of their peers. Graduate status.

ECI 535 Methods and Materials for Teaching Social Studies in the Middle Grades (3 credit hours)
For preservice middle school social studies teachers. Focus on: teaching and evaluation skills, adaptation of instruction to individual learner differences, identification and creation of instructional materials appropriate for use in social studies teaching. Cannot earn credit for ECI 435 and ECI 535.

Typically offered in Fall only

ECI 536/FL 436/ECI 436/FL 536 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.

GEP U.S. Diversity
Typically offered in Fall and Spring

ECI 537/ELM 537 Teaching Children's Literature (3 credit hours)
Instructions for educators in quality children's literature, specific needs of young reader, genres of children's literature, strategies for instructing children's literature, ways to target reader's interests, and design of literature units.

Typically offered in Summer only

ECI 540 Reading In the Elementary School (3 credit hours)
Theoretical foundations of reading instruction and current methods and materials for teaching reading, with emphasis on planning and implementing reading programs for children in kindergarten through grade six.

Prerequisite: Six hrs. ED or PSY
Typically offered in Fall only

ECI 541 Reading In the Content Areas (3 credit hours)
Methods in instruction for applying reading to content areas, with emphasis on means of improving comprehension, vocabulary and learning strategies in subject matter classrooms.

Prerequisite: Six hours in ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 543 Literacy Assessment and Intensified Instruction I (3 credit hours)
Designed for students to expand their knowledge and skills in diagnostic assessment and instruction in alphabetics and word study needed for K-12 Reading Specialist licensure. Topics include assessment and instruction in word recognition, word analysis, spelling, and early reading skills such as phonological awareness, alphabet knowledge, and concepts of print. Emphasis is placed on critical examination of reading intervention practices in these areas and implementation of innovative research-informed approaches for supporting diverse learners when they have difficulties with literacy in school.

Prerequisite: ECI 540 or ECI 541
Typically offered in Spring only

ECI 544 Literacy Assessment and Intensified Instruction II (3 credit hours)
Designed for students to expand their knowledge and skills in diagnostic assessment and instruction in language, comprehension, and inquiry needed for K-12 Reading Specialist licensure. Topics include assessment and instruction in fluency and print processing, comprehension, vocabulary/language, and text-based inquiry. Emphasis is placed on critical examination of reading intervention practices in these areas and implementation of innovative research-informed approaches for supporting diverse learners when they have difficulties with literacy in school.

Prerequisite: ECI 543
Typically offered in Fall only

ECI 545 Theory and Research in Literacy (3 credit hours)
Advanced study of theoretical models of reading, research issues in reading and in other language processes. In-depth theoretical models of reading. Emphasis on critical examination and analysis of research investigating reading acquisition, maturereading behavior and related language processes.

Prerequisite: ECI 540
Typically offered in Spring only

ECI 546 New Literacies & Media (3 credit hours)
Critical analysis of new literacies that are prompted by emerging technologies and participatory media in K-12. Design and application of new literacies and media instructional practices to literacy curriculum and other discipline areas.

Typically offered in Fall only

ECI 547 Knowledge Construction: Implications for Multicultural Education (3 credit hours)
Exploration of sociopolitical factors involved in the construction of knowledge in education as well as the implications for practitioners and learners in schools and other educational settings. Particular emphasis on critiquing traditional epistemologies that limit the production, dissemination, and validation of progressive discourses in education in order to promote the production of knowledge that affirms the principles of social justice education.

Prerequisite: ECI 500
Typically offered in Fall only

ECI 548/ECI 448 E-Business Applications in Business and Marketing Education (3 credit hours)
Emphasis on design and construction of advanced web pages, business and marketing applications of electronic commerce, as well as economic, social, legal, and ethical issues that are related to conducting business in a virtual environment. Content prepares students to apply principles to the business and marketing education curriculum in the public schools. Credit for both ECI 448 and ECI 548 is not allowed.

Typically offered in Fall and Summer

ECI 549 Special Problems in Reading (1-6 credit hours)
In-depth study of topical problems in reading education selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 550 Foundations Of Middle Years Education (3 credit hours)
Examination of five major aspects of middle years education: (a) history and purposes of middle/junior high school, (b) pre- and early adolescent needs, interests and abilities, Â¿ curriculum design and content, (d) teaching methods and (e) school organization. Emphasis on both theoretical understandings and effective classroom strategies.

Prerequisite: 6 hours of ED or PSY
Typically offered in Fall and Spring

ECI 551 Teaching/Learning Approaches For Emerging Adolescents (3 credit hours)
Exploration of teaching/learning approaches appropriate to emerging adolescents. Learning styles; interdisciplinary inquiry; community-based curriculum; simulations and games; learning centers; minicourses; design of physical space; all-school activities.

Prerequisite: ECI 550; Graduate standing
Typically offered in Spring only

ECI 552/AEHS 552 Program Development & Evaluation in Youth & Family Settings (3 credit hours)
Historical and contemporary foundations of program development and evaluation in non-formal, community-based family life and youth development settings are examined including theory, research, and three holistic program development constructs: 1) planning; 2) design and implementation; 3) impact evaluation and accountability.

Typically offered in Spring only

ECI 553/AEHS 553 Applied Concepts in Child and Youth Development (3 credit hours)
This course explores the fundamental concepts of child and youth development (including early childhood through adolescence) as applied to programmatic and organizational contexts. A special focus is placed upon the concepts as applied to Community Youth theories & practice.

Typically offered in Fall only

ECI 557/AEHS 557 Volunteerism in Youth and Family Settings (3 credit hours)
Preparation for current and future community-based youth and family professionals to better manage volunteers in local program service delivery. Specific foci include: volunteerism as a social phenomenon; volunteer resource management; new forms of volunteerism; and future trends in volunteerism. Restricted to graduate and post-baccalaureate students only.

Typically offered in Spring only

ECI 560 Professional Development in Business and Marketing Education (3 credit hours)
Designed to prepare business and marketing educators with the knowledge and skills necessary to design and implement strategies for organizational improvement that will benefit business and marketing education programs. Attendance and participation meaningful, organized professional development activity is an integral component of the course.

Prerequisite: Graduate standing
Typically offered in Summer only

ECI 561 Curriculum and Instruction in Business and Marketing Education (3 credit hours)
Designed to develop competencies needed to be a successful Business and Marketing Education Teacher-Coordinator. Focus primarily on the activities involved in planning and managing the curriculum and instructional skills needed to effectively implement the curriculum and meet educational needs of middle and high school students. For ED & MKZ students. Requires instructor approval.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ECI 562 Program Management in Business and Marketing Education (3 credit hours)
This course includes the administration of middle and secondary business and marketing education programs, including career guidance; the management of DECA or FBLA chapter; supervision of work-based learning strategies; and school program promotion and development. ED & MKZ students only. Requires permission of instructor.

Prerequisite: ECI 561
Typically offered in Fall and Spring

ECI 563 Methods and Materials in Teaching Secondary Social Studies (3 credit hours)
ECI 563 is a course that involves teaching techniques, innovations, development of teaching and evaluation skills, and in-depth subject matter inquiry in the area of secondary school social studies. Adaptation of instruction to individual learner differences, and selection and design of instructional materials will be explored. Must be enrolled in Secondary Social Studies MAT Program.

Typically offered in Fall only

ECI 566 Advanced Instructional Strategies in Business and Marketing (3 credit hours)
Advanced strategies and techniques related to teaching and learning in the business and marketing education curricula, classrooms, work places, and technology environments in middle and secondary education. MKZ students only.

Prerequisite: ECI 561
Typically offered in Spring only

ECI 567 Career and Technical Education Fundamentals and Program Administration (3 credit hours)
Emphasis on assisting various school district personnel in acquiring the knowledge and skills needed to effectively provide quality career and technical education (CTE) programming at the district level. Content includes federal CTE legislation, theory and research on educational reform, local and regional economic development, sources of funding for CTE programming and continuous improvement.

Typically offered in Fall and Spring

ECI 568 Designing College and Career Ready Programs (3 credit hours)
Examination of current school system instructional practices to assist various school district personnel in aligning core academic and career and technical education programming to prepare students for successful post-secondary education, careers, and life-long learning. Content includes an examination of education reform initiatives with an emphasis on foundational theory and research, needed workplace knowledge and skills, innovative education programs/models, and research-based best practices for success in transitioning students to post-secondary success.

Typically offered in Fall and Spring

ECI 569 Special Problems in Business and Marketing Education (1-6 credit hours)
In-depth study of topical problems in business and marketing education selected from areas of current concern to practitioners in education.

Typically offered in Fall only

ECI 570 Learning Disabilities (3 credit hours)
Field of learning disabilities, including definitions, prevalence, etiology, characteristics and current educational trends for educating students with learning disabilities.

Prerequisite: ECI 585
Typically offered in Summer only

ECI 571 Instructional Strategies for Students with Disabilities (3 credit hours)
Methods and materials for teaching students with disabilities in elementary and secondary school. Focus on research-supported instructional strategies for teaching academic skills, Universal Design for Learning, implementation of appropriate academic interventions, and evaluation of instructional outcomes within the context of Response to Intervention and Multi-Tier Systems of Supports.

Prerequisite: Graduate standing
Typically offered in Spring only

ECI 572 Resource Teaching In Special Education (3 credit hours)
Resource teaching in area of special education, with emphasis on resource teaching with students with special needs. Types of resource programs, establishment and maintenance of a program, selection of students, curriculum and materials.

Prerequisite: ECI 585
Typically offered in Summer only

ECI 573 Applied Behavior Analysis & Positive Behavior Intervention and Support in Schools (3 credit hours)
Concepts and procedures involved in design and implementation of techniques for managing the behavior of students in classroom setting. Focus on methods for defining, measuring, increasing, decreasing, maintaining, and generalizing classroom behaviors in all learners. An exploration of Multi-Tiered Systems of Support, and Positive Behavior Intervention and Support in school settings.

Typically offered in Fall only

ECI 574 Intellectual Disabilities (3 credit hours)
Content presented includes definitions, classifications, and assessment of person with intellectual disability from medical , sociological, and educational points of view. Issues related to labeling, etiology, characteristics, levels of severity, litigation, legislation, family and societal issues, history, and controversies are emphasized related to persons with intellectual disability.

Prerequisite: ECI 585
Typically offered in Fall only

ECI 575 Communication Disorders In the Classroom (3 credit hours)
Occurrence of communication disorders in the school-age population, including types of disorders, prevalence, etiology, characteristics and corrective therapy. Focus on communication disorders among exceptional students and classroom teacher's role in working with communication disorders.

Prerequisite: ECI 570

ECI 576 Teaching Functional and Life Skills to Students with Disabilities (3 credit hours)
Methods of instruction and materials related to teaching children and persons with mild-moderate levels of disability are emphasized. Effective general pedagogical approaches are stressed, as well as the teaching of functional academic skills, curricula used in instructions, teaching social and adaptive behavior as well as daily living skills, and transition-related skills necessary for independent adult life. Multi-tiered Systems of Support as well as Positive Behavior Intervention and Support are also discussed.

Typically offered in Spring only

ECI 577 Education Of Severely Handicapped (3 credit hours)
Severe and profound mental retardation and autism, including assessment procedures, educational and social/vocational programs, instructional strategies and evaluation. Legal and ethical issues involved in working with severely handicapped.

Prerequisite: ECI 585 or ECI 574

ECI 579 Organization and Behavioral Management of Inclusive Classrooms (3 credit hours)
To increase students' knowledge of persons with high incidence disabilities (i.e., learning disability, mild intellectual disability, and serious emotional disability), and how to manage the behavior of all pupils in educational environments. Characteristics of students with high incidence disabilities will be emphasized , as well as strategies to reduce the likelihood of problem behavior of all pupils in the classroom.

Typically offered in Fall, Spring, and Summer

ECI 580 Transition Program For Students With Mild Disabilities (3 credit hours)
Educational and other procedures involved in providing transition programming to students with mild disabilities. Examination of secondary-level special education service delivery, as well as post-secondary interventions, from critical, practical, empirical and theoretical perspectives.

Prerequisite: ECI 585
Typically offered in Summer only

ECI 581 Educational Diagnosis and Prescription For Children With Exceptionalities (3 credit hours)
Concept of educational diagnosis of students with exceptionalities, including examination of educational diagnostic procedures in current use in special education. Development of informal diagnostic techniques and procedures for adapting curriculum and instruction for learner with exceptionalities.

Prerequisite: ECI 585
Typically offered in Fall only

ECI 583 Behavior Disorders (3 credit hours)
Definitions, etiology, characteristics, philosophies and approaches to educational programming for children and youth with behavior disorders, including emotionally handicapped, autistic and socially maladjusted.

Prerequisite: ECI 585
Typically offered in Fall only

ECI 584 Intervention for Behavior Problems of Students with Disabilities (3 credit hours)
Curriculum materials, instructional strategies and behavior management techniques related to teaching children and youth with behavioral disorders including individualized instruction, group process, organization and evaluation of classroom programs, parent involvement, community resources and teachers' personal and professional growth and development.

Prerequisite: ECI 583
Typically offered in Spring only

ECI 585 Education of Children with Exceptionalities (3 credit hours)
Introduction to field of special education. Focus on historical overview, definitions and terminology in basic areas of exceptionality; etiological factors in exceptionality; developmental and learning characteristics of each area of exceptionality;and educational settings and strategies employed in special education including Multi-Tiered Systems of Support and Positive Behavior Intervention and Support. Review of current educational laws and policies affecting special education.

Prerequisite: 9 hours of ED or PSY
Typically offered in Fall and Spring

ECI 586 Introduction to Learning Analytics (3 credit hours)
As the use of digital resources continues expand in education, an unprecedented amount of new data is becoming available to educational researchers and practitioners. In response, Learning Analytics (LA) has emerged over the past decade as an interdisciplinary field encompassing Learning (e.g. educational technology, learning and assessment sciences), Analytics (e.g. visualization, computer/data sciences), and Human-Centered Design (e.g. usability, participatory design). This course will provide students with an overview of the field, examples of its use in educational contexts, and applied experience with widely adopted tools and techniques for working with and exploring data. As participants gain experience in the collection, analysis, and reporting of data throughout the course, they will be better prepared help educational organizations understand and improve learning and the contexts in which learning occurs.

Typically offered in Fall only

ECI 587 Machine Learning in Education (3 credit hours)
This class is meant to teach the practical side of machine learning for applications in mining educational data. There will be a heavy project focus, and when you have completed the course, you should be fully prepared to attack new problems using machine learning in the field of education.

Typically offered in Fall only

ECI 588 Text Mining in Education (3 credit hours)
This course will provide students with an overview of text mining as an analytical approach in education research, examples of its use in educational contexts, and applied experience with widely adopted tools and techniques (e.g. topic modeling and sentiment analysis). Students develop practical skills in the collection, analysis, and reporting of text data form sources such as Learning Management Systems, social media, and other online sources. Students can complete projects using a programming approach with R, a popular free open source software program for data science, or using non-programming point-and-click tools (i.e., SAS Visual Text Analytics).

Typically offered in Spring only

ECI 589 Analyzing Learning Networks (3 credit hours)
Although social network analysis and its educational antecedents date back to the early 1900s, the popularity of social networking sites like Twitter and Facebook have raised awareness of and renewed interests in networks and their influence. As the use of digital resources continues expand in education, data collected by these educational technologies has also greatly facilitated the application of network analysis to teaching and learning. This introductory course is designed to prepare researchers and practitioners to apply network analysis in order to better understand and improve student learning and the contexts in which learning occurs. This course will provide students with an overview of social network theory, examples of network analysis in educational contexts, and applied experience with widely adopted tools and techniques. As participants gain experience in the collection, analysis, and reporting of data throughout the course, they will be better prepared help educational organizations understand and improve both

Typically offered in Spring only

ECI 603 Advanced Seminar In Literacy Research (3-6 credit hours)
Critical analyses of research and methodology in reading comprehension processes and strategies for comprehension and retention of written discourse. Opportunity for design and conduct of a research project in reading or related area.

Prerequisite: ECI 648
Typically offered in Spring only

ECI 606 Seminar on Teacher as Learner: Developmental Theory, Research and Practice (3 credit hours)
Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.

Prerequisite: Graduate standing (6 hrs course work at 500-level)
Typically offered in Fall only

ECI 607 Advanced Seminar in Multicultural Education (3 credit hours)
Application and analysis of research and scholarship in multicultural education and topics related to effective schools for contemporary culturally diverse student populations in K-12 settings.

Prerequisite: Graduate standing and ECI 500
Typically offered in Spring only

ECI 620 Special Problems In Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hrs. of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 630 Independent Study in Curriculum and Instruction (1-3 credit hours)
Independent curriculum or research project in curriculum and instruction.

Typically offered in Fall, Spring, and Summer

ECI 640 Practicum In Curriculum and Instruction (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 641 Practicum In Mentoring and Coaching (1-6 credit hours)
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.

Prerequisite: ECI 705, Graduate standing in College of ED and PSY
Typically offered in Fall only

ECI 645 Supervised Practicum in Literacy (3 credit hours)
Supervised teaching experience with school-aged children identified as having reading difficulties. Students use diagnostic assessment data to design, implement, and evaluate individualized literacy instruction. Emphasis is placed on research-informed practices of intensified instruction embedded within engaging and authentic literacy experiences.

Prerequisite: ECI 540, ECI 541 and ECI 543; Graduate standing in College of ED
Typically offered in Spring only

ECI 647 Practicum in Business and Marketing Education (3 credit hours)
Supervised practical experiences in schools and area agencies concerned with business and marketing education.

Prerequisite: ECI 569
Typically offered in Spring only

ECI 648 Practicum in Special Education (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with teaching children and adolescents with disabilities.

Prerequisite: Graduate standing in College of ED and PSY
Typically offered in Fall, Spring, and Summer

ECI 650 Internship In Curriculum and Instruction (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 652 Field-Based Applications of Learning Design and Technology (1-6 credit hours)
Supervised opportunities to design, test, and revise learning design and technology solutions in authentic, field-based settings.

Typically offered in Fall and Spring

ECI 654 Internship In Elementary Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

Prerequisite: 3 hrs. grad.-level elementary education course work, Graduate standing in Col. of ED and PSY
Typically offered in Spring only

ECI 656 Internship In Middle Grades Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with the education of young adolescents.

Prerequisite: ECI 550, ECI 551, Graduate standing in College. of ED and PSY
Typically offered in Fall, Spring, and Summer

ECI 657 Internship in Business and Marketing Education (1-6 credit hours)
Supervised opportunities for advance professional development in contexts concerned with business and marketing education. Requires instructor approval.

Prerequisite: ECI 561
Typically offered in Fall and Spring

ECI 658 Internship In Special Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with special education.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 681 Seminar in Special Education Literacy (3 credit hours)
A case study approach is used in the seminar that requires the application of assessment techniques and instructional intervention methodologies in literacy for K-12 students with disabilities. Assigned activities require access to and experience in schools and/or related settings. This seminar is designed to be completed during the last half of the graduate program. It is restricted to graduate students in SPE, SPL, SPM, SPB or consent of instructor.

Prerequisite: ECI 540 or ECI 541 and ECI 581, ECI 585

ECI 682 Spe Ed Seminar in Teaching Numerical Concepts (3 credit hours)
This seminar is designed to prepare special education teachers to provide empirically supported instruction in numerical concepts and skills to students with disabilities in special education and general education settings. Particular attention will be paid to student characteristics that impact learning in arithmetic and mathematics and to addressing state and national curriculum standards using instructional organization and strategies that have been shown through research to be effective for this population. Field work in schools and/or related settings is required. Restricted to students in SPE, SPB, SPL, SPM or by consent of instructor.

Prerequisite: ECI 585
Typically offered in Summer only

ECI 683 Seminar in Special Education Learning Strategies (3 credit hours)
This seminar is designed to prepare special education teachers to evaluate and teach empirically supported learning strategies to students with disabilities in special education and collaborative settings. Particular attention will be paid to learning strategies shown to help students with disabilities organize, learn, and apply facts, skills and routines that provide access to and mastery of critical information across the curriculum. Field work in schools and/or related settings is required. Restricted to graduate students in SPE, SPB, SPL, SPM or consent of instructor.

Prerequisite: ECI 585

ECI 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the studnet in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall only

ECI 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECI 692 Research Projects In Curriculum and Instruction (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

ECI 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECI 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ECI 699/ELP 699/EMS 699/EOE 699/EAC 699/ECD 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECI 700 Curriculum Theory and Development (3 credit hours)
Theory and research in behavioral sciences and education designed to provide theoretical background for development of elementary and secondary curricula. Exploration of knowledge base and skills for critical review of curricula and instructional materials and provision of an application opportunity.

Prerequisite: 9 sem. hrs. graduate PSY, ECI 502, ECI 514
Typically offered in Fall only

ECI 705 Instructional Coaching and Supervision Of Teachers (3 credit hours)
Theory, research and practice of the professional role of a supervisor in the development of the effective and self-analytic teacher: pre-service (student teacher) and in-service (beginning and experienced teacher). For persons with at least two years of teaching experience in K-12 schools.

Typically offered in Spring only

ECI 709 Special Problems In Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hrs. of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 716 Design and Evaluation Of Instructional Materials (3 credit hours)
Characteristics and selection of various media for instruction and their use in educational settings. Design and production of instructional materials. Analysis of research in the field. Individualized projects and assignments. Application of grounded research and theory concerning learning to design of instructional materials. Structured projects and practical experiences used to transfer design principles and evaluate instructional products.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECI 719 Special Problems in Learning Design and Technology (1-6 credit hours)
In-depth study of topical problems in Learning Design and Technology selected from areas of current concern to practitioners in education.

Typically offered in Fall, Spring, and Summer

ECI 720 The Teaching Of Composition (3 credit hours)
For classroom teachers. Practical field-tested ideas to help students improve as writers by focusing on composition as a process as well as a product. Activities for teaching prewriting, drafting, revising, proofreading, grammar and evaluating with suggestions for individual and group learning. Writing in content areas and composition research/ theory.

Prerequisite: 9 hrs. of ED, PSY and/or ENG; to take this course in sum. as part of Capital Area Writing Project, student must apply and be selected
Typically offered in Spring only

ECI 721 Technology and Informal Learning Environments (3 credit hours)
Survey of theory and research grounding popular informal after-school technology environments, such as computer clubhouses, music studios, video clubs, coding camps, robotics clubs, and makerspaces. Examination of strategies for planning experiential, hands-on activities supportive of informal learning, sourcing necessary materials, outfitting spaces, facilitating student design and collaboration, and engaging the community and other resources to sustain facilities/clubs.

Typically offered in Fall only

ECI 722 Theory and Research in Distance Education (3 credit hours)
Introduction to distance education foundations, models, and underlying theories. Analysis of distance education research findings, research and evaluation methods, and management in varied settings--virtual schools, higher education, continuing education, and corporate e-learning. Application of distance education standards and research-based findings to the design of original course plans and materials prototypes, including appropriate recommendations for online teaching and community building, online student support, and online student assessment.

Typically offered in Spring only

ECI 727 Special Problems in Social Studies Education (1-6 credit hours)
In-depth study of topical problems in social studies education selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 729 Special Problems in English Education (1-6 credit hours)
In-depth study of topical problems in English education selected from areas of current concern to practitioners in education.

Prerequisite: Six hours of ED or PSY
Typically offered in Fall, Spring, and Summer

ECI 745 Literacy Theory and Research (3 credit hours)
Advanced study of theoretical models of reading, research issues in reading and in other language processes. In-depth theoretical models of reading. Emphasis on critical examination and analysis of research investigating reading acquisition, matureading behavior and related language processes.

Prerequisite: ECI 540
Typically offered in Spring only

ECI 801 Seminar In Curriculum and Instruction (1-3 credit hours)
Consideration of contemporary issues, trends and recent research and development findings in curriculum and instruction.

Prerequisite: Doctoral student
Typically offered in Fall only

ECI 803 Advanced Seminar In Literacy (3 credit hours)
Critical analyses of research and methodology in reading comprehension processes and strategies for comprehension and retention of written discourse. Opportunity for design and conduct of a research project in reading or related area.

Prerequisite: ECI 545
Typically offered in Spring only

ECI 804 Seminar On Attention Deficit Hyperactivity Disorder, Research and Treatment (3-6 credit hours)
Critical analysis of theory, research and interventions in Attention-Deficit-Hyperactivity-Disorder. Reading and synthesization of literature and student-led class discussions of such topics as characteristics, diagnosis, etiology, long-term outcomes and management of ADHD.

Prerequisite: 9 hrs. grad. credit in PSY or SPE
Typically offered in Spring only

ECI 806 Seminar on Teacher as Learner: Developmental Theory, Research and Practice (3-6 credit hours)
Analysis of major contemporary theories and research of learning and development as a basis for individual and organizational change and development in educational settings.

Prerequisite: Graduate standing (6 hrs course work at 500-level)
Typically offered in Fall only

ECI 807 Advanced Seminar in Multicultural Education (3 credit hours)
Application and analysis of research and scholarship in multicultural education and topics related to effective schools for contemporary culturally diverse student populations in K-12 settings.

Prerequisite: Graduate standing and ECI 500
Typically offered in Spring only

ECI 820 Special Problems In Curriculum and Instruction (1-6 credit hours)
In-depth study of topical problems in curriculum and instruction selected from areas of current concern to practitioners in education.

Prerequisite: Six hrs. of ED or PSY
Typically offered in Summer only

ECI 830 Independent Study in Curriculum and Instruction (1-3 credit hours)
Independent curriculum or research project in curriculum and instruction.

Typically offered in Fall, Spring, and Summer

ECI 840 Practicum In Curriculum and Instruction (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with curriculum and instruction or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 841 Practicum In Mentoring and Coaching (1-6 credit hours)
Supervised practical experiences in which participants become mentor to a student teacher or a teacher in a school system.

Prerequisite: ECI 705, Graduate standing in College of ED and PSY
Typically offered in Fall only

ECI 847 Practicum in Business and Marketing Education (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with business and marketing education.

Typically offered in Fall, Spring, and Summer

ECI 850 Internship In Curriculum and Instruction (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with curriculum development and/or educational supervision.

Prerequisite: Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 851 Internship In Mentoring (1-6 credit hours)
Supervised opportunities teaching educational personnel in local school systems how to serve as mentors to their colleagues.

Prerequisite: ECI 845 and ECI 705, Graduate standing in Col. of ED and PSY
Typically offered in Fall and Spring

ECI 880 Directed Study in Curriculum and Instruction (1-6 credit hours)
Curriculum or research project in curriculum and instruction under the direct supervision of a faculty member.

Typically offered in Fall and Spring

ECI 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ECI 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECI 892 Research Projects In Curriculum and Instruction (1-3 credit hours)
Project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 732
Typically offered in Spring only

ECI 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECI 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECI 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ECI 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, tull-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Dance (DAN)

DAN 210 Current Trends in Afrocentric and World Dance (1 credit hours)
This course provides direct experience in choreographic and performance processes for members of Panoramic Dance Project, NC State Dance Program's student company dedicated to Afrocentric and other culturally driven dance works. The course includes study of dance technique, choreographic craft, and the examination of content and identity in dance. Choreographic content varies from semester to semester. Permission only; acceptance by formal audition.

Typically offered in Fall and Spring

DAN 227 African Dance I (1 credit hours)
Development of beginning level skill of East and West African dances, including history, culture, and context, emphasizing the central role that dance plays in African cultures.

GEP Global Knowledge, GEP Health and Exercise Studies
Typically offered in Fall only

DAN 228 African Dance II (1 credit hours)
Development of intermediate level skills in traditional and contemporary African dances with clear distinction between different African regions. Emphasis will be placed on culture, history, community and theoretical aspects of each dance.

Corequisite: HESD 227 (African Dance I)
GEP Global Knowledge, GEP Health and Exercise Studies
Typically offered in Fall only

DAN 230 Horton Dance Technique (1 credit hours)
Development of beginning and intermediate-level skills in Horton dance technique, including alignment, vocabulary, performance, and history, with emphasis on strengthening the body for dance. Class format will include warm-up exercises, fortifications, studies, and traveling combinations. Course also includes the study of Lester Horton's influence on American modern dance, particularly in relation to integration in concert dance and the formation of Alvin Ailey American Dance Theater.

GEP Health and Exercise Studies, GEP U.S. Diversity
Typically offered in Fall only

DAN 234 Country Dance (1 credit hours)
This course is the development of beginning-level skills in country dance including vocabulary, technique, history, and performance. A variety of fundamentals for leading and following, combinations, figures, and calls will be emphasized in American Heritage Dance, Texas Two-step, and Western Square Dance.

GEP Health and Exercise Studies
Typically offered in Spring only

DAN 240 Social Dance (1 credit hours)
Development of beginning-level skills in social dance, including vocabulary, technique, history, performance, with emphasis on leading and following in the : Cha-Cha, Foxtrot, Waltz, Rumba, and Shag.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

DAN 241 Social Dance II (1 credit hours)
This course will focus on training students to understand and perform more complex dances in an improvisational environment. Emphasis will be on learning advanced level dance steps and combinations that are more challenging or complex social dances not currently offered in the beginning level class. Dances taught will differ from semester to semester.

Prerequisite: HESD 240 or equivalent skills
GEP Health and Exercise Studies
Typically offered in Fall only

DAN 260 Hip-hop Dance (1 credit hours)
This course introduces students to the physical, social, communal, historical, and cultural aspects of Hip-hop dance. Students might have to provide transportation and/or pay a minimal cost for a performance not to exceed $15.

GEP Health and Exercise Studies, GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall and Spring

DAN 261 Hip-hop Dance II (1 credit hours)
This course provides students with an intermediate level experience with the physical, social, communal, historical, and cultural aspects of Hip-hop dance. Emphasis will be on learning specific styles of Hip-hop, and delving into issues such as appropriation, commercialization, and community. Students might have to provide transportation and/or pay a minimal cost for a performance not to exceed $15.

Prerequisite: DAN 260
GEP Health and Exercise Studies, GEP U.S. Diversity
Typically offered in Spring only

DAN 263 Tap Dance (1 credit hours)
This beginning-level technique class covers basic tap dance skills in warm-up exercises, combinations, and compositions. Emphasis is placed on correct alignment in tap dance steps and the exploration of a variety of rhythms and patterns.

GEP Health and Exercise Studies
Typically offered in Spring only

DAN 264 Ballet I (1 credit hours)
Development of beginning-level technical skills in ballet, including vocabulary, technique, history, performance, alignment, function and access of turnout, with emphasis on safe and efficient body use.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

DAN 265 Ballet II (1 credit hours)
Further development of Ballet technique building on fundamental concepts and vocabulary introduced in Ballet I. Will include increased movement capabilities, rhythmic accuracy, alignment, performance, and access of turnout. A small fee may be required for dance concert attendance.

Prerequisite: HESD 264 or Instructor Permission
GEP Health and Exercise Studies, GEP Visual and Performing Arts
Typically offered in Fall only

DAN 272 Dance Composition - Solo Forms (1 credit hours)
This course introduces principles of dance composition through creative problem solving. Course content includes: movement invention; creation of a thematic phrase; manipulation and development of theme through application of choreographic devices; structure; and content. Student will create and perform a complete solo choreographic work in the course. A small fee of no more than $10 may be required for dance concert attendance.

Prerequisite: HESM 320 or instructor permission
GEP Visual and Performing Arts
Typically offered in Fall only

DAN 273 Jazz Dance I (1 credit hours)
This beginning-level technique class covers basic jazz dance skills in warm-up exercises, combinations, and compositions. A variety of jazz styles are covered including one or more of the following: classical (Luigi/ Giordano), Broadway, contemporary, Afro-jazz, and others.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

DAN 274 Modern Dance I (1 credit hours)
Development of beginning-level technical skills and movement concepts in modern dance, including vocabulary, technique, history, performance, and alignment, with emphasis on safe and efficient body use. Class format will include structured exercises and improvisations. A small fee may be required for dance concert attendance.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

DAN 275 Modern Dance II (1 credit hours)
Further development of modern dance technique, building on fundamental movement concepts and vocabulary introduced in Modern Dance I. Will include increased movement capabilities, rhythmic accuracy, and spatial relationships. A small fee may be required for dance concert attendance.

Prerequisite: HESD/DAN 274 (or permission of instructor)
GEP Health and Exercise Studies
Typically offered in Fall and Spring

DAN 276 Jazz Dance II (1 credit hours)
Further development of jazz dance technique building on fundamental concepts and vocabulary introduced in Jazz Dance I. Will include increased movement capabilities, rhythmic accuracy, alignment, and performance. A small fee may be required for dance concert attendance.

Prerequisite: HESD 273 or Instructor Permission
GEP Health and Exercise Studies, GEP Visual and Performing Arts
Typically offered in Spring only

DAN 279 Yoga I (1 credit hours)
This course will emphasize the practice of the eight limbs of yoga at an introductory level. Coursework will include the study of yoga culture, breathing exercises, meditation techniques, and a variety of yogasanas (postures): standing, twisting, balancing, forward bending, backward bending, and inversions. Students will develop the skills required to perform these postures and maintain a safe yoga practice.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

DAN 280 Yoga II (1 credit hours)
This course will build upon material introduced in Yoga I by emphasizing the practice of yoga at an intermediate level. Coursework will require a deeper level of understanding of a variety of yoga postures, breathing techniques, and meditation practices. Yoga philosophy will also be addressed through the study of historical yogic texts such as The Yoga Sutras of Patanjali.

Prerequisite: HESS 279
GEP Health and Exercise Studies
Typically offered in Spring only

DAN 281 Pilates (1 credit hours)
This course will teach the fundamentals of Pilates which are to improve body awareness, increase breathing capacity and improve postural alignment through simultaneous stretching and strengthening movements. The goal of Pilates exercises is to achieve optimal functional fitness. The knowledge and training gained from Pilates will not only benefit an individual in their daily activities, but also improve their performance in any physical activity they choose to participate in.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

DAN 290 Special Topics in Dance (1-4 credit hours)
Examination of selected topics in dance. May be repeated for credit provided course content is different each time.

DAN 295 Problems of Dance Performance (2 credit hours)
Practical performing experience in a company setting. Rehearsal, performance and production of concert dance.

Prerequisite: Audition
Typically offered in Fall and Spring

DAN 304 Dance Practicum (1 credit hours)
A 30-hour practical experience in the dance field. Assigned internships could include dance teaching, performing, choreographing, research, or other dance-related work dependent upon the student's experiences and interests. Specific placement will be determined by the student and the instructor. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Typically offered in Fall, Spring, and Summer

DAN 320 Movement Improvisation (1 credit hours)
Conceptually guided, spontaneous movement generation and invention reached through individual and group experiences.

Typically offered in Fall and Spring

DAN 322 Dance and Society (3 credit hours)
Dance and Society examines dance as an artistic, religious, cultural, and social form, including historic and aesthetic influences, basic dance elements, and relationship to other arts. This course incorporates multiple modalities of dance knowledge - lectures, films, demonstrations, and practical dance experience. A small fee may be required for concert attendance.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

DAN 326 Current Trends in Dance (3 credit hours)
Critical and contextual examination of current trends in dance. While specific readings and video resources will vary by semester as the field of dance continues to change, major course topics will include at least three of the following: the role of dance supporters and presenters, media influences, non-concert and site-specific dance, current movement trends, political significance, and international concerns.

GEP Visual and Performing Arts
Typically offered in Spring only

DAN 328 Dance Composition - Group Forms (2 credit hours)
This course builds on skills and concepts learned in Movement Improvisation. Various approaches to group choreography will be discussed and explored. A student-choreographed group work will be created and performed.

Prerequisite: HESM 320
GEP Visual and Performing Arts
Typically offered in Spring only

DAN 330 Introduction to Laban Movement Analysis and Bartenieff Fundamentals (2 credit hours)
An introduction to Laban Movement Analysis (LMA) and Bartenieff Fundamentals (BF) through movement integration, observation, notation, analysis, and application. LMA is a method and language for describing, visualizing, interpreting, and documenting all varieties of human movement. It consists of the study of four major components: Body, Effort, Shape and Space, the relationships between them, and ways of notating them. BF consists of a set of concepts, principles and exercises developed by Irmgard Bartenieff in applying Laban's movement theory to the physical/kinesiological functioning of the human body. LMA/BF is used by dancers, actors, musicians, and dance therapists, among others.

Typically offered in Spring only

DAN 332 Dance and Technology (2 credit hours)
The exploration of dance creation, performance, documentation, practice, and analysis through existing and emerging practices in technology and interactive media. Coursework will include working with audio, animation, prerecorded video, and live-captured media through Isadora, a real-time media manipulation tool for performance and visual artists.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

DAN 490 Adv Spec Top Dance (1-4 credit hours)

DAN 498 Independent Study in Dance (1-3 credit hours)
Independent study in special choreographic or performance projects approved by and done under the direction of the Dance Program. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: DAN 272, Dan 295, Dance Program approval required.
Typically offered in Fall only

Design (D)

D 100 Design Inquiry I: Methods and Processes (3 credit hours)
Design Inquiry I asks students to think critically about and experiment with expanding their toolkit of process and methods in solving large scale problems with innovative solutions. Through discussion sections, students will also be introduced to methods of critical reading and writing as a reflective practice. Topics students will consider and implement include lateral thinking, metaphorical thinking, abductive reasoning, networked thinking, discourse as thought, systems thinking and more. Students in Design must receive a C- to pass the course.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

D 101 Design Inquiry II: Methods and Processes (3 credit hours)
As an important extension of the first semester, Design Inquiry II asks students to engage in the critical evaluation of the making process and how design and the artifacts that we create contribute to material culture. Lecture topics are both historical and contemporary and include: design in the age of reason, the age of composition, and the age of experience; consumption and material culture; designing the obsolete; human-centered design, and universal design. Student in Design must receive a C- to pass the course.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

D 104 First Year Studio I (6 credit hours)
First Year Studio I provides College of Design freshman with an introduction to foundational design concepts and methods representative of creative activity across design and artistic disciplines. This 6-credit fall semester course encourages entering freshman to think critically and act creatively about and upon design, art and the world around them as they secure a skillful level of craftsmanship in the conception, development, and making of all studio-based work. Semester work focuses on key design issues such as process, method, technique, technology and the production of visual and physical items necessary for the envisioning and development of design. College of Design Studio Majors Only; Students must receive a C- to pass the course.

Co-requisite: D 100; restricted to Design majors only
Typically offered in Fall only

D 105 First Year Studio II (6 credit hours)
First Year Studio II is the continuation of a comprehensive introduction to foundational design concepts and methods begun in First Year Studio I. This 6-credit fall semester course asks freshman to think critically and act creatively about and upon design, art, and the world around them as they apply a skillful level of craftsmanship in the conception, development, and making of all studio-based work. In this discipline specific second semester studio, students acquire further knowledge of design and art through assignments and projects that explore their design major. College of Design Studio Majors Only; Students must receive a C- to pass the course.

Prerequisite: D 100 and D 104; Restricted to Design majors only
Typically offered in Spring only

D 231 Design History for Engineers and Scientists (3 credit hours)
Study of historical connections among various disciplines and across cultures from prehistory to the present, with an emphasis on design. Students develop visual timelines of events to better understand how seemingly disparate disciplines affect one another. Special attention paid to scientific, artistic, and philosophical "revolutions" and their impact upon each other and upon other intellectual and practical endeavors. There are no prerequisites or corequisites for this course. Design Studies students should consult with the Instructor prior to enrollment for their own benefit.

GEP Visual and Performing Arts
Typically offered in Fall only

D 292 Special Topics in Design (1-3 credit hours)
Topics of current interest in the college of Design. Used to develop new courses.

Typically offered in Fall, Spring, and Summer

D 492 Special Topics in Design (1-6 credit hours)
Topics of current interest in the College of Design. Used to develop new courses.

Typically offered in Fall, Spring, and Summer

D 592 Special Topics in Design (1-6 credit hours)
Topics of current interest in the College of Design. Used to develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

D 684 Teaching Design at the College Level (3 credit hours)
Preparation for college level teaching in the design disciplines. Discussion of the history of design education, curriculum development, pedagogical strategies, assessment, and teaching and research demands on college design faculty. Meets partial requirements for the university Certificate of Accomplishment in Teaching. Restricted to students enrolled in College of Design masters and doctoral programs.

Typically offered in Spring only

Design courses for Graduate Students (DDN)

DDN 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's Student
Typically offered in Fall only

DDN 696 Summer Thesis Res (1 credit hours)

DDN 701 Research Methods in Design (3 credit hours)
Survey of research methods in the field of design including overall systems of inquiry, criteria for assessing quality, strategies and tactics. Strengths and weaknesses of various research designs. Experimental and quasi-experimental research, correlational research, qualitative research strategies, simulation and modeling research, action research and design intervention, case study, and combined strategies.

Prerequisite: Graduate standing
Typically offered in Spring only

DDN 702 Research Paradigms in Design (3 credit hours)
Overview of contributions and limitations of various theoretical perspectives that inform the field of design inquiry. Knowledge and theory construction. Nature, scope, and merits of scientific approach. Criticism of the scientific approach and examination of alternative approaches utilized in design research and practice. Linking philosophy, research, and action/practice/application.

Prerequisite: Graduate standing
Typically offered in Fall only

DDN 740 Introduction to Practice-Based Design Research (3 credit hours)
This course presents an introduction and overview of interdisciplinary research theories, strategies, and methods as applied to issues in professional practice of design. Special emphasis is placed on the roles, values, and specific methods related to design practice, including (not limited to) case study analysis and evaluation; design typology; engaged research; research and development (e.g. prototyping); and design process. Course content is adaptable to student needs and interests. Restricted to Doctor of Design (D.Des) students; other advanced post-professional design students may enroll with permission of instructor. Although course content and instruction is predominantly online, the course requires one week of face-to-face intensive on-campus instruction and other activities before Fall term begins (TBA).

Restriction: Doctor of Design Students or other advanced students (PhD or other DDes programs off campus) may be enrolled by permission of instructor only.
Typically offered in Fall only

DDN 741 Case Study Analysis in Design (3 credit hours)
The case study method addresses the importance of learning how to learn as an essential element of professional growth as well as a means toward building a culture of reflective design practice. Case studies provide orientation and perspective on the complexity of design practice, both for novices and seasoned professionals. When closely examined, lessons learned from design processes and decision-making provide opportunities to build a body of professional knowledge. Course content is adaptable to student needs and interests. Restricted to Doctor of Design (D.Des) students; other advanced post-professional design students may enroll with permission of instructor. Although course content and instruction is predominantly online, the Fall course requires one week of face-to-face intensive on-campus instruction and other activities prior to the start of Fall term. The Spring course requires one week of face-to-face intensive on-campus instruction and other activities during Spring term (TBA).

Corequisite: DDN 740
Typically offered in Fall and Spring

DDN 771 Design as Cognitive Artifact (3 credit hours)
Relationship between theories of human cognition and design. Analysis and critique of design objects as cognitive artifacts and extension, transformation, or diminishing of human thought by their form and content. A critical examination of cognitive, linguistic and social science theories shaping design.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831
Typically offered in Fall and Spring

DDN 772 Design as Cultural Artifact (3 credit hours)
Recent theories in various disciplines concerning a cultural understanding of graphic design. Theories of mass and popular culture, critiques of creativity and authorial intentionality, influences of interpretive criticism, theories of consumption and issues of cultural representation. Emphasis on adaptation of these theories to an understanding of the cultural significance of graphic design. Non-majors by permission only.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831
Typically offered in Fall only

DDN 773 New Information Environments (3 credit hours)
Changing role of design in new information environments. Implications of new technology on social construction of meaning, impact of electronic media on culture and cognition, and differences in designing artifacts and designing interactions.

Prerequisite: Doctoral student, Design Majors, Corequisite: DDN 830 or 831
Typically offered in Spring only

DDN 779 Human Use of the Urban Landscape (3 credit hours)
Techniques for documenting and analyzing user needs at cite planning scale. Methods of integrating user needs into design programming in design and redesign projects. Community participation methods. Examples of best practice in design of user-intensive settings in residential, health, education and recreation. Principles of Universal Design. Fieldwork-oriented.

Typically offered in Spring only

DDN 795 Special Topics (3-6 credit hours)
Typically offered in Fall and Spring

DDN 809 Dissertation Colloquium (1 credit hours)
Prerequisite: Doctoral student in Design
Typically offered in Spring only

DDN 810 Special Topics (1-6 credit hours)

DDN 830 Independent Study (1-3 credit hours)
Typically offered in Fall and Spring

DDN 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student in Design
Typically offered in Fall, Spring, and Summer

DDN 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student in Design
Typically offered in Fall, Spring, and Summer

DDN 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student in Design
Typically offered in Fall, Spring, and Summer

DDN 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student in Design
Typically offered in Summer only

DDN 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student in Design
Typically offered in Fall, Spring, and Summer

Design Studies (DS)

DS 100 Design in Culture and Context (3 credit hours)
Design in Culture and Context is a first year seminar for Design Studies majors. The course examines design action and the relationships between design and other systems, chiefly the natural and built environment, society and culture, and technology and economics. Recent independent studies, field projects, and special initiatives by artists, designers, and principal investigators will introduce students to the negotiations that take place among the decision-makers, manufacturers, and civic and community patrons in understanding the nature and limits of a variety media, processes of design, and the cultural implications of researching meaningful solutions to current challenges and public needs.

Prerequisite: D 100; Design Studies Majors only
Typically offered in Spring only

DS 200/ADN 200 A Survey of Design Studies (3 credit hours)
This course will introduce students to a variety of perspectives and lenses through which to examine and evaluate design in the world. Students will consider design studies through theory and criticism of design, as well as applied to business administration, museum studies, and environmental studies. In addition, students will be encouraged to find evidence of and define design studies in areas that are uniquely suited to their individual areas of interest. As an advised elective, this course is required for Design Studies majors who are sophomores in their major.

Typically offered in Fall only

DS 481 Design Studies Senior Research Seminar (3 credit hours)
Each student in Design Studies will develop a topic for his or her Senior Capstone Research Paper to be done during the Spring term. During the Research semester, each student will develop a comprehensive bibliography for the topic and an outline ofthe paper. One paper will be written before the end of the term that addresses issues directly related to the Capstone Research paper. Throughout the term, students will share their research with others in the seminar.

Prerequisite: Completion of all course work in DS through junior year ; Design Studies Majors
Typically offered in Fall only

DS 482 Design Studies Capstone Seminar (1 credit hours)
Students will meet on a weekly basis to discuss their individual research papers. Drafts of papers will be due at the end of the eighth week of class. Drafts will be read by the instructor, other instructors of the student's choosing, and by two other members of the class for critical analysis.

Prerequisite: DS 481 ; Design Studies Majors
Typically offered in Spring only

DS 483 Design Studies Capstone Research Paper (3 credit hours)
Course consists of guided independent study resulting in a serious research paper. Students will work on their own, with meetings with faculty advisor(s) at weekly intervals.

Prerequisite: DS 481 ; Design Studies Majors
Typically offered in Spring only

DS 494 Design Studies Internship (1-6 credit hours)
Supervised internships in museums, galleries, schools, or other approved venues, in which students are engaged in activities related to Design Studies. Students are responsible for transportation to and from internship. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior or Senior Standing in Design Studies Program ; Design Studies Majors
Typically offered in Fall, Spring, and Summer

Ecology (ECO)

Economics (EC)

EC 201 Principles of Microeconomics (3 credit hours)
Scarcity, production possibilities, and opportunity cost. Supply and demand analysis, free markets, the price system, and government policy. Microeconomic analysis of business decisions in competitive and noncompetitive markets. Labor markets, capital, and natural resource markets, and externalities. Market breakdown, income redistribution, and role of government. Free trade, tariffs, and gains from international trade. Credit will not be given for both EC 201 and either ARE 201 or EC 205.

Credit is not allowed for both EC 201 and EC 205 or ARE 201.
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

EC 202 Principles of Macroeconomics (3 credit hours)
Aggregate economic analysis emphasizing current public policy issues. Determinants of level and rate of growth of total output. Causes of unemployment and business cycles, inflation, and exchange rate fluctuations. Effects of monetary policy (money supply) and fiscal policy (government spending, taxes, deficits) on these problems. Trade surpluses/deficits and impact of international events and policies on national economies. Credit will not be given for both EC 202 and EC 205.

Prerequisite: EC 201 or ARE 201 or EC 205
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

EC 205 Fundamentals of Economics (3 credit hours)
Fundamental ideas in economics: scarcity, substitution, opportunity cost, marginal analysis, gross domestic product, real and nominal magnitudes. Supply and demand analysis. Microeconomic analysis of pricing in competitive and noncompetitive markets. Macroeconomic analysis of production, employment, the price level, and inflation. Monetary and fiscal policy and the stabilization of the economy. Comparative advantage and international trade. Credit will not be given for both EC 205 and either EC 201 or ARE 201. Credit will not be given for both EC 205 and EC 202.

Credit is not allowed for both EC 205 and EC 201 or ARE 201 or EC 202.
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

EC 301/ARE 301 Intermediate Microeconomics (3 credit hours)
Functioning of the market economy, role of prices in determining the allocation of resources, the functioning of the firm in the economy, forces governing the production and consumption of economic goods.

Prerequisite: MA 121 or MA 131 or MA 141 and EC 201 or EC 205 or ARE 201
Typically offered in Fall, Spring, and Summer

EC 302 Intermediate Macroeconomics (3 credit hours)
Applied, analytical course in aggregate economics: business cycles, stabilization policy, inflation, costs of disinflation, international trade, and economic growth. Interaction of consumers and businesses with government economic policies; unemployment, interest rates, and output growth. Impacts of government deficits, trade deficits, and monetary policies.

Prerequisite: (EC 201 or EC 205 or ARE 201)and (MA 121 or MA 131 or MA 141)
Typically offered in Fall, Spring, and Summer

EC 305 A Closer Look at Capitalism (3 credit hours)
Comparison of market allocation to government allocation. Criteria for evaluating economic systems. How markets create value. Relationship of economic freedom to political freedom and economic growth. Applications to policies such as antitrust policy, education policy, and environmental policy.

Prerequisite: EC 201 or EC 205 or ARE 201.
Typically offered in Fall only

EC 336/ARE 336 Introduction to Resource and Environmental Economics (3 credit hours)
Application of basic economic tools to understand and evaluate environmental/resource policies. Concepts such as property rights, non-market goods, allocation over time, externalities, and public goods. Current policy issues such as global climate change, evaluating natural resource damages from oil spills, reducing the costs of regulations, protecting estuaries, and dealing with non-point source pollution.

Prerequisite: ARE 201 or EC 201 or EC 205
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EC 348 Introduction to International Economics (3 credit hours)
Application of basic economic analysis to international economic events and policies. Gains from trade, impacts of trade restrictions, international systems of payments, global capital markets, and balancing international with domestic macroeconomic policies. Current policy issues such as economic integration (customs unions and free trade areas), a common European currency, and the role of international trade in economic growth and development.

Prerequisite: EC 201 or EC 205 or ARE 201.
Typically offered in Fall only

EC 351 Econometrics I (3 credit hours)
Tools for describing and analyzing data as used in economics. Probability, random variables, sampling, point and interval estimation. Hypothesis testing and regression analysis with emphasis on economic applications. Statistics majors may not enroll in EC 351. Statistics majors interested in enrolling in EC 451 will satisfy the prerequisite of EC 351 with ST 430.

Prerequisite: BUS/ST 350 or ST 312 or ST 370 or ST 372
Typically offered in Fall and Spring

EC 404 Money, Financial Markets, and the Economy (3 credit hours)
Roles of money, credit, and financial institutions in the modern economy. Determination of level and structure of interest rates and exchange rates, determination of security prices. Management and regulation of financial institutions. Federal Reserve System and monetary policy. Statistical analysis of financial and monetary data.

Prerequisite: EC 302 and (BUS/ST 350, or ST 312, or ST 370, or ST 372)
Typically offered in Spring only

EC 410 Public Finance (3 credit hours)
A micro-economic analysis of the rationale for public expenditure and taxation. Externalities, pollution and public policy, income redistribution and public welfare, public goods, collective choice and political institutions, public budgeting techniques and cost-benefit analysis, taxation and tax policy, state-local finance and fiscal federalism.

Prerequisite: EC/ARE 301
Typically offered in Spring only

EC 413 Industrial Organization (3 credit hours)
An overview of industrial organization, including the study of monopoly, oligopolistic behavior, monopolistic competition, product differentiation and the dynamic behavior of competitive industries under uncertainty.

Prerequisite: EC/ARE 301
Typically offered in Spring only

EC 431 Labor Economics (3 credit hours)
An economic approach to the labor market and its problems including unemployment and the determination of wages, hours and working conditions under various labor market structures. The economic effects of trade unions. Introduction to human capital theory.

Prerequisite: EC/ARE 301
Typically offered in Fall and Spring

EC 449 International Finance (3 credit hours)
Study of international markets and their effects on firms, investors and national economics. Topics include: futures and options in foreign exchange, management of foreign exchange risk, exchange rate determination, and macroeconomic policy in an open economy.

Prerequisite: EC/ARE 301
GEP Global Knowledge
Typically offered in Fall only

EC 451 Econometrics II (3 credit hours)
The measurement, specification, estimation and interpretation of functional relationships through single equation least-square techniques. Applications of simple and multiple regression, curvilinear regression and various transformations to demand, cost, production, consumption and investment relationships.

Prerequisites: EC/ARE 301, EC 302, and EC 351 (or ST 430 for Statistics majors)
Typically offered in Fall and Spring

EC 468 Game Theory (3 credit hours)
Studies the competitive and cooperative behavior that results when several parties with conflicting interests must work together. Learn how to use game theory to analyze situations of potential conflict. Applications are drawn from economics, business, and political science.

Prerequisite: EC 301
Typically offered in Fall and Spring

EC 474 Economics of Financial Institutions and Markets (3 credit hours)
Management, development and regulation of U.S. financial markets and institutions. Management of major financial intermediaries and their historical development. Analysis of major financial assets and their markets. The role and history of the Federal Reserve and other financial regulators.

Prerequisite: (MA 121 or MA 131 or MA 141) and EC 302
Typically offered in Spring only

EC 490 Research Seminar in Economics (3 credit hours)
The final course for students completing the undergraduate programs in economics. Students study a selected economic issue, make classroom presentations related to the seminar topic, and write research papers.

Prerequisite: EC/ARE 301 and EC 302 and (BUS/ST 350 or ST 312 or ST 370 or ST 372)
Typically offered in Fall and Spring

EC 495 Special Topics in Economics (1-6 credit hours)
Examination of special topics in economics not normally treated in other courses, or offering of new courses on a trial basis.

EC 498 Independent Study in Economics (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Director of Undergraduate Programs. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Educ Leadership & Program Eval (ELP)

ELP 296 Special Topics in Education: General Studies (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall, Spring, and Summer

ELP 344 School and Society (3 credit hours)
The interrelationship between the school and other institutions, values, and patterns of thought in American society.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

ELP 496 Special Topics in Education: General Studies (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior standing or Senior standing
Typically offered in Fall, Spring, and Summer

ELP 515 Education and Social Diversity (3 credit hours)
Overview of role of education within a culturally diverse society. Major attention to racial, socioeconomic and regional subpopulations. Issues discussed include subcultural influences on public school performances, equality of educational opportunity, social stratification and mobility, and the impact of schooling on intergroup relations.

Typically offered in Fall only

ELP 518 Introduction To Education Law (3 credit hours)
Relationship of constitutional, statutory and case law to elementary and secondary public school settings, particularly in areas of students, teachers and liability. Particular emphasis on N.C. and federal law.

Typically offered in Spring only

ELP 550 Principles of Educational Leadership and Empowerment (3 credit hours)
Examines school organization theories and critical domains of leadership (e.g., school vision, culture, management, collaboration, ethics, and environments). Develops conceptual, managerial and interpersonal leadership skills through analysis of school goals and purpose; organizational design, development and improvement; curricular and instructional leadership; and school-community relationships. Instructional activities will include lecture, seminar discussion, case and problem-based analysis. Graduate standing required.

Typically offered in Fall only

ELP 551 Context and Challenges of School Improvement (3 credit hours)
Examination of social, cultural, political and policy environment of schooling with emphasis on NC. Analysis of major theories of school change and development. critical examination of opportunities and barriers to strategic change efforts. Instructional activities will include lecture, sminar discussion, case and problem-based analysis.

Typically offered in Spring only

ELP 552 School-Based Planning, Management, and Evaluation in Professional Learning Communities (3 credit hours)
Prepares administrators to strategically plan, manage and evaluate core programs and systems for the safe and efficient operation of schools. Operational domains examined will include information systems, management systems, curriculum, instruction, student behavior and school security systems. Instructional activities include lecture, sminar discussions, case, situation and problem-based analysis.

Typically offered in Fall only

ELP 553 Organizational Management I: Human Resource Management in K-12 Education (3 credit hours)
Examination and application of models, theories, and research pertaining to personnel appraisal in education, including recruitment hiring, retention, and dismissal; evaluation models for professional and classified staff; use of effective professional development models to support professional growth and development.

Typically offered in Fall only

ELP 554 Organizational Management II: Resource Support and Sustainability in K-12 Education (3 credit hours)
Theories and practices of funding K-12 education including examination of: political frameworks and policy issues; concepts central to education finance and budgeting; purposes, designs, and uses of school budgets; procedures for generating, analyzing and interpreting issues related to education finance and school budgeting. Construct, manage and analyze school and district-level budgets; address issues of economic efficiency, equity and fiscal adequacy and their fiscal impact on the school community. Understand North Carolina's Uniform Chart of Accounts accounting structure for school budgeting.

Corequisite: ELP 553
Typically offered in Spring only

ELP 595 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

ELP 620 Special Problems In Education (1-6 credit hours)
Opportunity for graduate students in education to study problem areas in professional education under direction of member of graduate faculty.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

ELP 651 Internship In Educational Leadership and Program Evaluation (1-9 credit hours)
Utilization of participant-observer role and required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Required development of possible alternative courses of action in various situations, selection of one of alternatives and evaluation of consequences of selected course of action.

Prerequisite: Nine hrs. in grad.-level courses
Typically offered in Fall and Spring

ELP 699/EMS 699/EOE 699/EAC 699/ECD 699/ECI 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring

ELP 724 Contemporary Educational Thought (3 credit hours)
Reading and discussion of 20th-century works in educational philosophy. Consideration of such movements as pragmatism, reconstruction, perennialism and existentialism.

Typically offered in Fall, Spring, and Summer

ELP 728 School Law For the Administrator (3 credit hours)
Comprehensive study of constitutional, statutory and case law as related to elementary and secondary school administration. Emphasis on legal issues associated with governance, finance, property, personnel and curriculum.

Typically offered in Spring only

ELP 729 Educational Finance (3 credit hours)
Historical and sociopolitical contextual analysis of underlying values, methodologies and policies associated with economic and financial planning of K-12 education (e.g., efficiency, equity, and liberty) and the economic and financial mechanisms used to generate, distribute, and expend revenues for educational purposes.

Typically offered in Fall only

ELP 735 Policy Research in Education (3 credit hours)
This course will draw on both classic and contemporary materials in educational policy research and will primarily focus on the substance of policy research rather than methodology. It addresses research pertaining to the foundations, implementation and evaluation of policy in all levels and sectors of the educational system. Major attention will be given to education in the United States, with comparative perspectives included.

Typically offered in Fall, Spring, and Summer

ELP 751 Politics of P-12 Education (3 credit hours)
Analysis of political interactions of individuals and groups in P-12 education, specifically, how politics shapes educational decisions within a federal system of governance. Topics covered include micropolitics and macropolitical systems at the school, district, municipal, state, and federal levels, as well as political culture, interest groups, advocacy coalitions, and institutions. Doctoral standing required.

Typically offered in Fall only

ELP 753 Data Decision Making for School Administrators (3 credit hours)
Understand the purposed and uses of school data for research-based school improvement. Understand different types of assessment needed for school and district-wide improvement. Develop models of administrative decision making incorporating key goals, resources, curriculum alignment, data, assessment, and evaluation. Doctoral student status required.

Typically offered in Spring only

ELP 756 Organizational Leadership & Mangement for School Leaders (3 credit hours)
Prepares district-level administrators to analyze the changing nature of the superintendency, including major management and leadership responsibilities and leadership approaches. Operational domains examined include school governance and organizational theory, school boards, school district policy, collaborative leadership, material and human resource management, systemic and sustainable reform, contemporary challenges, and personal practices management. Doctoral standing required.

ELP 780 Evaluation Theory and Practice In Education (3 credit hours)
Review of educational program evaluation with emphasis on (1) theory and conceptual models of evaluation, (2) evaluation design, and (3) environmental practical factors influencing design and implementation of evaluation studies.

Typically offered in Fall only

ELP 795 Special Topics (1-6 credit hours)
Special Topics in Educational Research and Leadership

ELP 820 Special Problems In Education (1-6 credit hours)
Opportunity for graduate students in education to study problem areas in professional education under direction of member of graduate faculty.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

ELP 851 Internship In Educational Leadership and Program Evaluation (1-9 credit hours)
Utilization of participant-observer role and required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Required development of possible alternative courses of action in various situations, selection of one of alternatives and evaluation of consequences of selected course of action.

Prerequisite: Nine hrs. in grad.-level courses
Typically offered in Fall, Spring, and Summer

ELP 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

ELP 891 Problems Of Research Design In Education (1-3 credit hours)
Provision of individualized but structured investigation of alternative problem definitions, research methodologies and statistical analyses for a problem of student's choosing, usually associated with thesis or dissertation. In small groups or individually with instructor, student consideration of research design, measurements and statistical analysis necessary to conduct research.

Prerequisite: ELP 742
Typically offered in Fall, Spring, and Summer

ELP 892 Research Projects In Educational Leadership and Program Evaluation (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. Research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Typically offered in Fall, Spring, and Summer

ELP 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ELP 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Education (ED)

ED 100 Intro to Education (2 credit hours)
This course serves as an introduction to the field of education and as an orientation to the College and University experience. Students will examine the knowledge, skills, and dispositions necessary to become effective educators of diverse populations. Topics include student success strategies, professional standards for teachers, and resources in the College of Education. This course is restricted to College of Education students only.

Restriction: College of Education Students only, others by permission of the College of Education
GEP U.S. Diversity
Typically offered in Fall and Spring

ED 101 Freshman Teaching Fellows Forum I (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education.Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Fall only

ED 103 Intro to University Education (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Through technology-assisted plenary and small group seminars, students will examine the knowledge, skills and dispositions necessary to become globally aware, ethical, reflective students of diverse populations in the 21st century. Topics include academic skills, student success strategies, community and diversity; major and career decision making; assessment of interests, skills, and values; available university resources; overview of university majors and minors as well as policies and procedures. This course is restricted to Wake STEM Early College students only.

Typically offered in Fall only

ED 104 Intro to University Education II (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Through technology-assisted plenary and small group seminars, students will examine the knowledge, skills, and dispositions necessary to become globally aware, ethical, reflective students of diverse populations in the 21st century. Topics include academic skills, student success strategies, community, and diversity; major and career decision making; assessment of interests, skills, and values; available university resources; overview of university majors and minors as well as policies and procedures. This course is restricted to Wake STEM Early College students only. Students will be required to provide their own transportation if they choose a co-curricular activity that is off campus.

Restriction: This course is restricted to NC State Wake STEM Early College students.
Typically offered in Spring only

ED 150 Students Advocating for Youth I (1 credit hours)
Building upon a passion for advocacy. Investigating issues related to youth in today's North Carolina. Exploring youth advocacy and ethics. Exploring youth advocacy and diversity. Exploring youth advocacy as a vocation. Practical youth advocacy field work. Participation in field experiences required. Restricted to students admitted to the SAY program.

Typically offered in Fall only

ED 151 Students Advocating for Youth II (1 credit hours)
Continuing to build upon a passion for advocacy. Understanding how legistlation and policy affects youth advocacy and youth organizations. Exploring changes within the career field. Exploring peer influence processes among youth. Practical youthadvocacy field work. Participation in field experiences required. Field experience may extend beyond normal class time. Restricted to students admitted to the SAY program.

Prerequisite: ED 150
Typically offered in Spring only

ED 201 Sophomore Teaching Fellows Forum I (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education.

Prerequisite: Students in Teaching Fellows Program
Typically offered in Fall only

ED 204 Introduction to Teaching in Today's Schools (2 credit hours)
Overview of teaching as work and as a profession in today's schools. Course focuses on establishing a respectful environment for a diverse student population, dispositions and practices required for effective teaching, integration of digital technology into K-12 settings, and taking informed action through service learning. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase intern liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge, which typically ranges between $12-50 depending on the year and organization used.

Prerequisite: Sophomore standing; Corequisite: ECI 204, or EMS 204, or EMS 205, or TDE 202
Typically offered in Fall and Spring

ED 296/ECI 296 Special Topics in Education (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

Typically offered in Fall and Spring

ED 299/FL 299 Field Experience for 21st Century Teaching (1 credit hours)
This course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Foreign Language Education majors.

Prerequisite: ECI 204 and ED 204
Typically offered in Spring only

ED 301 Junior Teaching Fellows Forum I (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education.Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Fall only

ED 302 Junior Teaching Fellows Forum II (1 credit hours)
Topics related to educational issues and requirements of the Teaching Fellows program. Topics will include current practices, policies and research in education.Restricted to Students Admitted to the Teaching Fellows Program

Typically offered in Spring only

ED 311 Classroom Assessment Principles and Practices (2 credit hours)
This course will enable candidates to understand and use appropriate classroom assessment practices to promote positive student achievement. Candidates will learn to use knowledge of standards, student needs, and data-driven instruction to design and implement formative and summative assessments. ED 311 also examines the rationale for assessment, implications of assessment, and the varied ways assessment data is used by stakeholders both within and outside of the K-12 classroom.

Prerequisite: Admission to Teacher Education Candidacy (gpa 2.75) AND course prerequisite of ED 204, or ELM 250, or AEE 206; Co-requisite: ED 312
Typically offered in Fall and Spring

ED 312 Classroom Assessment Principles and Practices Professional Learning Lab (1 credit hours)
This class is a co-requisite professional learning lab to ED 311, Classroom Assessment Principles and Practices, wherein teacher candidates are exposed to practical applications of the ED 311 course topics. The course has a required fieldwork component in local K-12 schools, and candidates are responsible for their own transportation to and from the schools. Candidates are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors. Course Prerequisite / Co-requisite: P-R: Admission to Candidacy; Co-R: ED 311

Prerequisite: Admission to Teacher Education Candidacy (gpa 2.75) and ED 204, ELM 250, or AEE 206; Co-requisite: ED 311
Typically offered in Fall and Spring

ED 403 Teaching Fellows Senior Seminar (1 credit hours)
A casebook study of first-year teacher experiences and an examination of professional, ethical, and legal issues in education as found in cases dealing with new teachers.

Prerequisite: Senior standing
Typically offered in Fall and Spring

ED 496/ECI 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior standing or Senior standing
Typically offered in Fall and Spring

ED 507 Principles of Developing and Interpreting Assessment (2 credit hours)
Designed to enable students to understand and use appropriate classroom assessment practices by applying knowledge of pedagogy and development to high-quality strategies for formative and summative assessment. Students will explore best practices using developmentally-appropriate assessment strategies including authentic assessment, portfolios, and electronic portfolios, real-time feedback, open-and closed-ended formal assessments, and standardized testing. Particular attention will be paid to examining the rationale for assessment, and the implications of assessment.

Typically offered in Fall, Spring, and Summer

ED 508 Exploring Diversity in Classroom and Community (3 credit hours)
Students will explore and apply the major philosophical and historical influences to current educational context as they relate to issues of diversity. Focus will be placed on theoretical and practical issues of diversity in classroom settings, especially related to culture, race, gender, ethnicity, language, and socio-economic levels. (Field-based experiences will be required).

Typically offered in Fall, Spring, and Summer

ED 569 Teaching Internship: MAT (4 credit hours)
A supervised teaching experience requiring a minimum of 10 consecutive full-time weeks in an appropriate school classroom. Designed to develop the knowledge, skills, and dispositions necessary for teaching at the elementary, middle and/or secondary level. Includes regularly scheduled clinical observations and conferences. Requires successful completion of at least 21 hrs. in the MAT program and approval by specialty area faculty. Student responsible for transportation to placement site.

Typically offered in Fall and Spring

ED 570 Classroom Action Research (1 credit hours)
Provides a brief introduction to educational research focusing specifically on classroom action research. Requires admission to MAT; completion of 6 hours in the program.

Typically offered in Fall, Spring, and Summer

ED 571 Inquiry and Professional Development (1 credit hours)
Builds on earlier course work (ED 570) preparing students to refine an action research proposal, collect data in a school setting, write a report, and to identify resources and activities that will support their ongoing professional development; requires 9 hours of graduate credit in the MAT curriculum.

Typically offered in Fall, Spring, and Summer

ED 572 Teacher Leadership (1 credit hours)
This course explores the multiple contexts, roles, and approaches to teacher leadership in classrooms, schools, communities, and professional organizations. Requires at least 30 credit hours in the MAT program.

Typically offered in Fall and Spring

ED 590 Special Problems in Teaching and Learning (1-6 credit hours)
In-depth study of topical problems in teaching and learning of current and special interest to K-12 Classroom teachers.

Typically offered in Fall, Spring, and Summer

ED 605 Special Problems in Teaching (1-3 credit hours)
In-depth study of topical problems in teaching selected from areas of current concern to K-12 teachers.

Prerequisite: Graduate standing

ED 700 Introduction to Research Design in Education (3 credit hours)
Survey of the field of educational research specifically with regard to the modes of inquiry, variety of methodologies, and ethical standards for conducting research with human participants. Limited to doctoral students in Education or by permission of instructor.

Typically offered in Fall only

ED 710 Applied Quantitative Methods in Education I (3 credit hours)
This course is designed for educational researchers and leaders to gain experience with designing and evaluating research using a quantitative approach to answer research questions in educational research and policy analysis. Students will examine design issues in research, create data sets, develop research questions from data provided, use a variety of descriptive and inferential procedures to answer formulated research questions, interpret the results and write the results in the language of educational research. Restricted to doctoral students in Education or by permission of instructor.

Prerequisite: ED 700, or ECI 510, or ELP 532, or ST 507
Typically offered in Fall, Spring, and Summer

ED 711 Applied Quantitative Methods in Education II (3 credit hours)
Students will apply and enhance their quantitative skills through analysis of existing datasets. Course goals include practicing and extending Multiple Regression knowledge and skills, generating and testing hypotheses in a multiple regression framework, and appropriately disseminating results. Restricted to doctoral students in Education Research only.

Prerequisite: ED 710
Typically offered in Fall, Spring, and Summer

ED 712 Survey Methods in Educational Research (3 credit hours)
Introduces students to the skills and resources needed to design and conduct a survey in educational settings. Students who take this course will be able to identify and develop specific survey objectives, design survey studies, sample respondents, develop reliable and valid self-administered questionnaires, administer surveys, and process data.

Prerequisite: ED 710
Typically offered in Fall only

ED 714 Workflow of Data Analysis in Education (3 credit hours)
The rule of thumb for a quantitative research project in education is that about 70%-80% of your time will be spent on creating the dataset to be analyzed. The purpose of this course is to provide you with the set of practical skills that you need to successfully design and complete a quantitative research project in education, especially the dissertation. Students will learn how to create, merge, collapse and reshape datasets, create variables, deal with missing data via multiple imputation, and automate statistical output into Excel.

P: ED 710 or the equivalent. Given the nature of this course, you should have some experience with Stata. Please contact me as soon as possible if you have never used Stata.
Typically offered in Spring and Summer

ED 730 Introduction to Qualitative Research in Education (3 credit hours)
Design of qualitative studies, conduct of field work including open-ended interviews and participant observation, analysis of data and understanding of theoretical and philosophical background of this research approach.

Typically offered in Fall, Spring, and Summer

ED 731 Advanced Qualitative Research and Data Analysis in Education (3 credit hours)
Intensive course in the use of field-based and general qualitative research data analysis methods in the social study of education. The course is to help participants acquire skills and gain experience in using various methodological and analytical research techniques. The course emphasis is on the collection, management, analysis, and interpretation of qualitative data.

Prerequisite: ELP 736, EAC 785 or ED 730
Typically offered in Fall and Spring

ED 750/EDP 750 Mixed Methods Research in Education (3 credit hours)
Explores the theoretical and practical issues surrounding the combining of quantitative and qualitative methods in educational research studies. It addresses how to design, implement and write-up mixed methods research as well as how to critically review and interpret mixed methods research studies.

Prerequisite:ED 711,ED 730,ST 507, ELP736 or equivalent and/or permission of the instructor
Typically offered in Fall and Spring

ED 755 Scholar Leader: Diversity and Equity in Schools and Communities (3 credit hours)
The objective of this course is to inform you about the research and theories related to diversity (race/ethnicity, gender, social class, sexuality, ability, intersectionality and more) and equity in schools and communities for application to your own personal and professional experiences. This process will provide you with a foundation from which you may base your own decisions in your profession. As the course proceeds, your role will be to try to understand what you hear and read and to ask questions, to formulate an opinion about the theories/concepts that are presented, and to connect what you read to your own experiences as a human being, graduate student, and professional.

Typically offered in Fall, Spring, and Summer

ED 756 Scholar Leader: Systemic Change in Education (3 credit hours)
This is a required course for students in College of Education PhD programs. It is designed to help prepare students to engage in informed analysis, critique and planning of education policies and programs designed to foster systemic changes in K-16 education. A central focus will be the intersection of research, policy, and practice in efforts to update and improve education systems, and the social and political complexities of educational reform.

Typically offered in Fall and Spring

ED 795 Special Topics in Education Research (3-6 credit hours)
This course provides in-depth instruction and applications in new or emerging areas of educational research, studies or venues. May be repeated for credit if topic changes. Doctoral students in education only.

Typically offered in Fall, Spring, and Summer

Educational Psychology (EDP)

EDP 304 Educational Psychology (3 credit hours)
Psychological principles applied to education, including cognitive and personality development, individual differences, learning and behavior theory, cognitive strategies for learning and remembering, critical thinking and problem-solving strategies, student motivation, classroom management techniques, components of teacher effectiveness, measurement and student evaluation procedures, characteristics of exceptional children, mainstreaming in the classroom, and multicultural education.

Prerequisite: Sophomore standing
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

EDP 370 Applied Child Development (3 credit hours)
Students will explore how biological, cognitive, and social/emotional development affects children's learning and behavior. The course will focus on applying important theories and current findings in development to issues in education such as lesson planning, curriculum design, behavior management, motivation, an appropriate assessment. Students will also apply knowledge of development to issues such as creating actively engaging individuated experiences to deal with gifted students, students with diverse ethnic or cultural backgrounds, and students with exceptionalities or disabilities.

Prerequisite: Sophomore standing
GEP Social Sciences
Typically offered in Fall only

EDP 476/PSY 476 Psychology of Adolescent Development (3 credit hours)
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.

Prerequisite: PSY 200 or EDP 304
Typically offered in Summer only

EDP 504 Advanced Educational Psychology (3 credit hours)
A critical appraisal of current psychological findings relevant to educational practice and theory.

Prerequisite: Graduate standing
Typically offered in Spring only

EDP 560 Educational Testing and Measurement (3 credit hours)
The study of principles of educational testing and measurement, particularly classroom assessment, including norm and criterion referenced assessment, classroom testing methods and principles,standardized testing and measurement, item analysis, and an introduction to basic descriptive statistics. A brief introduction to innovative assessment is also included.

Prerequisite: Graduate standing
Typically offered in Spring only

EDP 575/ECD 575 Multicultural Lifespan Development (3 credit hours)
This course surveys theories, principles, and issues of psychological development throughout the lifespan. Emphasis will be placed on understanding current developmental research and its application to the enhancement of development from birth to late adulthood. Implications for helping professionals working in multicultural contexts will be provided.

Prerequisite: Six Hours of Graduate Study
Typically offered in Spring and Summer

EDP 582/PSY 582 Adolescent Development (3 credit hours)
Current theories and research on development during adolescence. Topics include: physical growth, cognitive changes, relationships with peers, parents and teachers, quest for identity and independence, morality and sexuality.

Prerequisite: 6 hours in PSY
Typically offered in Fall only

EDP 590 Special Problems in Educational Psychology (1-6 credit hours)
In-depth study of topical problems in cognition, motivation, assessment, or other educational psychology area of current and special interest to educators.

Typically offered in Fall, Spring, and Summer

EDP 605 Special Problems in Educational Psychology (1-6 credit hours)
In-depth study of topical problems in educational psychology selected from areas of current concern to educators.

Typically offered in Fall, Spring, and Summer

EDP 696 Summer Thesis Res (1 credit hours)

EDP 704 Theories and Research in Educational Psychology (3 credit hours)
Review and synthesis of pertinent literature in specialized topics and areas of research in educational psychology. Topic selection will vary by semester and instructor. Graduate standing or permission of instructor.

Doctoral students only (DR)
Typically offered in Fall only

EDP 723 Motivation in Education (3 credit hours)
The purpose of this course is to inform students about motivation theories and how various concepts from these theories are related to education practice. The course components are designed to provide students with an understanding of research in motivation, as well as the relationships between theoretical perspectives of human motivation and the teaching practice.

P: ED 700 or equivalent
Typically offered in Spring only

EDP 750/ED 750 Mixed Methods Research in Education (3 credit hours)
Explores the theoretical and practical issues surrounding the combining of quantitative and qualitative methods in educational research studies. It addresses how to design, implement and write-up mixed methods research as well as how to critically review and interpret mixed methods research studies.

Prerequisite:ED 711,ED 730,ST 507, ELP736 or equivalent and/or permission of the instructor
Typically offered in Fall and Spring

EDP 896 Summer Dissert Res (1 credit hours)

EGR-Engineering Master's (EGR)

EGR 501 Engineering Leadership and Strategic Change (3 credit hours)
In the current business environment, an understanding of leadership and change management is essential to career success. The objective of this course is to provide practitioners in technical fields the knowledge to lead, align and transform the human element, individuals and teams, to achieve organizational performance excellence. The class includes both individual and collaborative (team) learning. An engineering, technical, or scientific undergraduate degree is required.

Typically offered in Fall and Spring

EGR 503 Statistical Engineering using Six Sigma DMAIC Process (3 credit hours)
Statistical Engineering: systematic approach (Six Sigma DMAIC methodology) for improving manufacturing and business processes and products using advanced graphical and statistical methods. Defining the improvement opportunity, measurement system analysis (MSA), Failure Mode and Effects Analysis (FMEA), data collection, graphical and statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of statistical engineering to business and manufacturing case studies.

ST 361 or ST 370 or Entry Level Statistics
Typically offered in Fall and Spring

EGR 505 Managerial Finance for Engineers (3 credit hours)
In the current business environment, familiarity with and appreciation of finance is essential to career success. Technically competent managers must be able to speak the common language of business and to understand how their work affects the performance of their organization. The objective of this course is to provide practitioners in technical fields the financial know-how to plan, control and make decisions that achieve organizational performance excellence. The class includes both individual and collaborative (team) learning. An engineering, technical or scientific undergraduate degree is required.

Typically offered in Fall and Spring

EGR 506 Managing New Hi Tech Product Launches (3 credit hours)
This course covers new high-tech product development and launch from the perspective of the technical manager responsible for developing and launching new products and new lines of business within the high tech firm. Topics cover the entire spectrum of the new products development and launch process starting from concept generation and ideation and concept evaluation all the way through market testing and product launch. Each phase of the new products management process will be covered and illustrated by case studies. Students will generate a new product development and launch plan as a course project..3 credit hours.

Requirement: Graduate standing in Engineering
Typically offered in Spring and Summer

EGR 507 Product Life Cycle Management (3 credit hours)
This course covers the management of complex technical products during all phases of the product life cycle. It is a broad survey of all the tools needed by the technical product manager throughout the life cycle of a complex product. The course is taught with a systems approach and from the engineering manager's viewpoint. The product life cycle includes all aspects of managing products from launch through maturity.

Requirement: Graduate standing in Engineering
Typically offered in Fall, Spring, and Summer

EGR 590 Special Topics in Engineering (1-6 credit hours)
Discussion of special topics in engineering. Identification of various specific topics and prerequisites for each section from term to term.

Typically offered in Fall, Spring, and Summer

EGR 688 Non-Thesis Masters Continuous Registration-Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Electrical and Computer Engineering (ECE)

ECE 109 Introduction to Computer Systems (3 credit hours)
Introduction to key concepts in computer systems. Number representations, switching circuits, logic design, microprocessor design, assembly language programming, input/output, interrupts and traps.

Typically offered in Fall, Spring, and Summer

ECE 200 Introduction to Signals, Circuits and Systems (4 credit hours)
Ohm's law and Kirchoff's laws; circuits with resistors, photocells, diodes and LEDs; rectifier circuits; first order RC circuits; periodic signals in time and frequency domains, instantaneous, real and apparent power; DC and RMS value; magnitude andpower spectra, dB, dBW, operational amplifier circuits, analog signal processing systems including amplification, clipping, filtering, addition, multiplication, AM modulation sampling and reconstruction. Weekly hardware laboratory utilizing multimeter, function generator, oscilloscope and spectrum analyzer and custom hardware for experiments on various circuits and systems.

Prerequisite: Cum GPA 2.5 or above (or NTR) , C or better in MA 241 and PY 205
Typically offered in Fall, Spring, and Summer

ECE 209 Computer Systems Programming (3 credit hours)
Computer systems programming using the C language. Translation of C into assembly language. Introduction to fundamental data structures: array, list, tree, hash table.

Prerequisite: Grade of C- or better in ECE 109
Typically offered in Fall, Spring, and Summer

ECE 211 Electric Circuits (4 credit hours)
Introduction to theory, analysis and design of electric circuits. Voltage, current, power, energy, resistance, capacitance, inductance. Kirchhoff's laws node analysis, mesh analysis, Thevenin's theorem, Norton's theorem, steady state and transient analysis, AC, DC, phasors, operational amplifiers, transfer functions.

Prerequisite: C- or better in ECE 200 and Corequisite: ECE 220
Typically offered in Fall, Spring, and Summer

ECE 212 Fundamentals of Logic Design (3 credit hours)
Introduction to digital logic design. Boolean algebra, switching functions, Karnaugh maps, modular combinational circuit design, latches, flip-flops, finite state machines, synchronous sequential circuit design, datapaths, memory technologies, caches, and memory hierarchies. Use of several CAD tools for simulation, logic minimization, synthesis, state assignment, and technology mapping.

Prerequisite: C- or better in ECE 109
Typically offered in Fall, Spring, and Summer

ECE 220 Analytical Foundations of Electrical and Computer Engineering (3 credit hours)
This course is designed to acquaint you with the basic mathematical tools used in electrical and computer engineering. The concepts covered in this course will be used in higher level courses and, more importantly, throughout your career as an engineer. Major topics of the course include complex numbers, real and complex functions, signal representation, elementary matrix algebra, solutions to linear systems of equations, linear differential equations, laplace transforms used for solving linear differential equations, fourier series and transforms and their uses in solving ECE problems. EE and CPE Majors Only.

Prerequisite: C- or better in ECE 200
Typically offered in Fall, Spring, and Summer

ECE 298 Special Projects in ECE (1-4 credit hours)
Faculty-supervised special projects in electrical and/or computer engineering. Projects involve small groups of students, working collaboratively or independently, focused on a single theme, such as the design of a component or system. Requires a "Course Agreement for Students Enrolled in Non-Standard Courses," completed by the student and faculty member prior to registration by the department.

R: EE or CPE majors
Typically offered in Fall, Spring, and Summer

ECE 301 Linear Systems (3 credit hours)
Representation and analysis of linear systems using differential equations: impulse response and convolution, Fourier series, and Fourier and Laplace transformations for discrete time and continuous time signals. Emphasis on interpreting system descriptions in terms of transient and steady-state response. Digital signal processing.

Prerequisite: C- or better in ECE 211 and ECE 220.
Typically offered in Fall, Spring, and Summer

ECE 302 Microelectronics (4 credit hours)
Introduction to the physics of semiconductors, PN Junctions, BJT and MOS field Effect Transistors: Physics of operation, IV characteristics, load line, quiescent point of operation, PSPICE analysis; diode circuit analysis; voltage regulation; Single Stage Transistor Amplifiers: Common Emitter and Common Source configurations, biasing, inverting and non-inverting amplifiers; follower circuits; calculation of small signal voltage gain, current gain, coupling and bypass capacitors; Multistage ac-coupled amplifiers; small signal modeling; input resistance and output resistance; logic inverters.

Prerequisite: A grade of C- or better in ECE 211
Typically offered in Fall, Spring, and Summer

ECE 303 Electromagnetic Fields (3 credit hours)
This course prepared the students to formulate and solve electromagnetic problems relevant to all fields of electrical and computer engineering and that will find application in subsequent courses in RF circuits, photonics, microwaves, wireless networks, computers, bioengineering, and nanoelectronics. Primary topics include static electric and magnetic fields, Maxwell's equations and force laws, wave propagation, reflection and refraction of plane waves, transient and steady-state behavior of waves on transmission lines. Restriction: EE and CPE Majors Only.

Prerequisite: A grade of C- of better in ECE 211 and ECE 220
Typically offered in Fall, Spring, and Summer

ECE 305 Principles of Electromechanical Energy Conversion (3 credit hours)
Three-phase circuits and power flow, analysis of magnetic circuits, performance of single-phase and three-phase transformers, principles of electromechanical energy conversion, steady-state characteristics and performance of alternating current and direct current machinery.

Prerequisite: C- or better in ECE 211 or ECE 331
Typically offered in Fall, Spring, and Summer

ECE 306 Introduction to Embedded Systems (3 credit hours)
Introduction to designing microcontroller-based embedded computer systems using assembly and C programs to control input/output peripherals. Use of embedded operating system.

Prerequisite: C- or better in ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 308 Elements of Control Systems (3 credit hours)
Analog system dynamics, open and closed loop control, block diagrams and signal flow graphs, input-output relationships, stability analyses using Routh-Hurwitz, root-locus and Nyquist, time and frequency domain analysis and design of analog control systems. Use of computer-aided analysis and design tools. Class project. EE, CPE, BME majors only.

Prerequisite: (ECE 220 and ECE 211) or BME 311; Co-requisite: ECE 301
Typically offered in Fall and Spring

ECE 309 Data Structures and Object-Oriented Programming for Electrical and Computer Engineers (3 credit hours)
Advanced programming topics focusing on data structures and object-oriented programming. Common data structures, including linked lists, hash tables, trees, balanced trees, heaps, graphs, and B-trees, are described, analyzed, and implemented. Object-oriented programming topics, classes, inheritance, polymorphism, abstract types, and generic types are described and applied to program design.

Prerequisite: C- or better in ECE 209
Typically offered in Fall and Spring

ECE 310 Design of Complex Digital Systems (3 credit hours)
Design principles for complex digital systems. Decomposition of functional and interface specifications into block-diagrams and simulation with hardware description languages. Synthesis of gate-level descriptions from register-transfer level descriptions. Design and test of increasingly complex systems.

Prerequisite: A grade of C- or better in ECE 212
Typically offered in Fall and Spring

ECE 331 Principles of Electrical Engineering (3 credit hours)
Concepts, units and methods of analysis in electrical engineering. Analysis of d-c and a-c circuits, characteristics of linear and non-linear electrical devices; principles of operational amplifiers; transformers; motors; and filters.

Prerequisite: PY 208 and a C or better in MA 241
Typically offered in Fall, Spring, and Summer

ECE 380 Engineering Profession for Electrical Engineers (1 credit hours)
Introduction to engineering as a profession including issues surrounding electrical engineering. Topics include professional and ethical responsibilities, risks and liabilities, intellectual property, and privacy. Economic issues including entrepreneurship and globalization.

Pre-requisites: C- or better in ECE 211 and ECE 212 and ECE 220
Typically offered in Fall and Spring

ECE 381 Engineering Profession for Computer Engineers (1 credit hours)
Introduction to engineering as a profession including issues surrounding computer engineering. Topics include professional and ethical responsibilities, risks and liabilities, intellectual property, and privacy. Economic issues including entrepreneurship and globalization.

Pre-requisites: C- or better in ECE 211 and ECE 212 and ECE 220
Typically offered in Fall and Spring

ECE 383 Introduction to Entrepreneurship and New Product Development (1 credit hours)
This course is part of the Engineering Entrepreneurs Program. Students work as team members on projects being led by seniors completing their senior capstone design. Students will be exposed to many areas of product development and will assist in the design and implementation of the prototype product.

Typically offered in Fall and Spring

ECE 384 Practical Engineering Prototyping (3 credit hours)
This course will teach prototyping skills, standard tools, and best practices to convert a project concept into a functioning, verifiable prototype. Course topics include understanding component specifications, system schematics, system functionality verification, power calculations and measurements, driver circuit designs, soldering and wiring procedures, basic MCU programming, Printed Circuit Board design and test, and debugging/test/verification tools/methods and procedures. Quick workshops on sensor interfacing, standard circuits and off-the-shelf systems, mobile app design, prototype packaging, and patent search resources will also be included in this course. Students will be required to complete several prototyping activities outside of class. This course is an open elective recommended to be taken before or at the same time as the capstone classes for Electrical and Computer (ECE) Engineering. Students are expected to have some basic knowledge about what is ac-dc, dc-dc voltage converters, motors, transistors, op-amps, and MOSFETS.

Prerequisites: (ECE 200 and ECE 209 and ECE 211) or their equivalent
Typically offered in Summer only

ECE 398 Special Projects in ECE (1-4 credit hours)
Faculty-supervised special projects in electrical and/or computer engineering. Projects involve small groups of students, working collaboratively or independently, focused on a single theme, such as the design of a component or system. Requires a "Course Agreement for Students Enrolled in Non-Standard Courses," completed by the student and faculty member prior to registration by the department.

C: ECE 301 or ECE 302 or ECE 303 or or E 304 or ECE 305 or ECE 306 or ECE 308 or ECE 309 or ECE 310; R: EE and CPE majors
Typically offered in Fall, Spring, and Summer

ECE 402 Communications Engineering (3 credit hours)
An overview of digital communications for wireline and wireless channels which focuses on reliable data transmission in the presence of bandwidth constraints and noise. The emphasis is on the unifying principles common to all communications systems, examples include digital telephony, compact discs, high-speed modems and satellite communications.

P: ECE 301 and ST 371; R: EE and CPE Majors Only
Typically offered in Fall, Spring, and Summer

ECE 403 Electronics Engineering (3 credit hours)
Design and analysis of CMOS integrated circuits, from single transistor stages to operational amplifiers. Feedback in operational amplifier circuits, compensation and stability. ECE majors only.

Prerequisite: ECE 301, ECE 302
Typically offered in Spring only

ECE 404 Introduction to Solid-State Devices (3 credit hours)
Basic principles required to understand the operation of solid-state devices. Semiconductor device equations developed from fundamental concepts. P-N junction theory developed and applied to the analysis of devices such as varactors, detectors, solar cells, bipolar transistors, field-effect transistors. Emphasis on device physics rather than circuit applications.

P: ECE 302 or E 304; C: EE, CPE, NanoScience and Technology Majors Only
Typically offered in Fall and Spring

ECE 406/CSC 406/CSC 506/ECE 506 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall and Spring

ECE 407 Introduction to Computer Networking (3 credit hours)
This course focuses on engineering principles of computer communications and networking, including layering concepts, overview of protocols, architectures for local, metropolitan, and wide-area networks, routing protocols, internet operations, transport control and applications, emerging issues in computer networks. EE and CPE majors only.

Prerequisite: ECE 301
Typically offered in Fall and Spring

ECE 411 Introduction to Machine Learning (3 credit hours)
Learning from experience is one of the hallmarks of intelligence. Machine learning is the study of computer algorithms that improve automatically through experience. Machine learning, a subfield of artificial intelligence (AI), has achieved remarkable progress over the past decade, especially in deep learning. This course introduces fundamental concepts and algorithms that are vital for understanding state-of-the-art and cutting-edge development toward the next wave of AI. This course also exposes students to real-world applications via well-guided homework programming problems, as well as group projects. Topics include, but are not limited to optimization, linear statistical models, kernel regression, support vector machines, boosting machines, and deep neural networks.

P: (ECE 301 or ISE 361 or MA 341 or CSC 316) and (ST 370 or ST 371)
R: Students may not receive credit for both CSC 422 and ECE 411.
Typically offered in Fall and Spring

ECE 418/BME 418/BME 518/ECE 518 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.

Prerequisite: Senior standing
Typically offered in Fall only

ECE 420 Wireless Communication Systems (3 credit hours)
A study of applications of communication theory and signal processing to wireless systems. Topics include an introduction to information theory and coding, basics and channel models for wireless communications, and some important wireless communication techniques including spread-spectrum and OFDM. MATLAB exercises expose students to engineering considerations.

Prerequisite: ECE 402
Typically offered in Fall and Spring

ECE 421 Introduction to Signal Processing (3 credit hours)
Concepts of electrical digital signal processing: Discrete-Time Signals and Systems, Z-Transform, Frequency Analysis of Signals and Systems, Digital Filter Design. Analog-to Digital-to-Analog Conversion, Discrete Fourier Transform.

Prerequisite: ECE 301
Typically offered in Fall, Spring, and Summer

ECE 422 Transmission Lines and Antennas for Wireless (3 credit hours)
Review of time-varying electromagnetic theory. A study of the analytical techniques and the characteristics of several useful transmission lines and antennas. Examples are coaxial lines, waveguides, microstrip, optical fibers and dipole, monopole and array antennas.

Prerequisite: ECE 303
Typically offered in Fall only

ECE 423 Introduction to Photonics and Optical Communications (3 credit hours)
This course investigates photonic devices at the component level and examines the generation, propagation, and detection of light in the context of optical communication systems. Topics include the design of simple optical systems and focuses on the use of lasers, fiber optics, and photodetectors. The labs include building a Michelson interferometer, preparing and coupling light to an optical fiber, characterizing LEDs and laser diodes and making a fiber optical link.

Prerequisite: ECE 303 or Permission of the Instructor
Typically offered in Fall only

ECE 424/ECE 524 Radio System Design (3 credit hours)
Introduction to communication theory and radio system design. Design and analysis of radio systems, such as heterodyne transceivers, and effects of noise and nonlinearity. Design and analysis of radio circuits: amplifiers, filters, mixers, baluns and other transmission line and discrete circuits.

Prerequisite: ECE 302
Typically offered in Spring only

ECE 426 Analog Electronics Laboratory (3 credit hours)
A hands on laboratory based course with two construction projects (dual power supply, high frequency buffer amplifier) and six breadboard based activities with a focus on operational amplifiers and their applications. Student must have a portable computer and 'Digilent Analog Discovery'. Topics include: amplifier performance, integrator/differentiator, filters, converters (I to V, V to I) and audio circuits.

Prerequisite: ECE 302
Typically offered in Fall and Spring

ECE 434 Fundamentals of Power Electronics (3 credit hours)
Design, analysis, modeling and control of DC-DC converters, DC-AC inverters, AC-DC rectifiers/converters, and AC-to-AC converters. power conversion using switched high-voltage high-current semiconductors in combination with inductors and capacitors. Design of DC-DC, DC-AC, AC-DC, and AC-AC power converters as well as an introductions to design of magnetic components for use in power converters, apllications to fuel cells, photovoltaics, motor drives, and uninterruptable power supplies

Prerequisite:ECE 302 or equivalent
Typically offered in Fall only

ECE 436 Digital Control Systems (3 credit hours)
Discrete system dynamics, sampled-data systems, mathematical representations of analog/digital and digital/analog conversions, open- and -closed-loop systems, input-output relationships, state-space and stability analyses, time and frequency domain analysis with emphasis on time domain. Design and implementation of digital controllers. Design project including hardware implementation.

Prerequisite: ECE 308
Typically offered in Spring only

ECE 442 Integrated Circuit Technology and Fabrication (3 credit hours)
Semiconductor device and integrated-circuit processing and technology. Wafer specification and preparation, oxidation, diffusion, ion implantation, photolithography, design rules and measurement techniques.

Prerequisite: ECE 404
Typically offered in Fall only

ECE 451 Power System Analysis (3 credit hours)
Long-distance transmission of electric power with emphasis on load flow, economic dispatch, fault calculations and system stability. Applications of digital computers to power-system problems. Major design project.

Prerequisite: ECE 305
Typically offered in Fall only

ECE 452/ECE 552 Renewable Electric Energy Systems (3 credit hours)
Principles and characteristics of renewable energy based electric power generation technologies such as photovoltaic systems, wind turbines, and fuel cells. Main system design issues. Integration of these energy sources into the power grid. Economics of distributed generation. Credit is not allowed for both ECE 452 and ECE 552.

Prerequisite: ECE 305 or ECE 331
Typically offered in Spring only

ECE 453 Electric Motor Drives (3 credit hours)
Principles of electromechanical energy conversion; analysis, modeling, and control of electric machinery; steady state performance characteristics of direct-current, induction, synchronous and reluctance machines; scalar control of induction machines; introduction to direct- and quadrature-axis theory; dynamic models of induction and synchronous motors; vector control of induction and synchronous motors.

Prerequisite: A grade of C or better in ECE 305.
Typically offered in Spring only

ECE 455 Industrial Robotic Systems (3 credit hours)
Techniques of computer control of industrial robots: interfacing with synchronous hardware including analog/digital and digital/analog converters, interfacing noise problems, control of electric and hydraulic actuators, kinematics and kinetics of robots, path control, force control, sensing including vision. Major design project. EE, CPE, BME, JEM majors only.

Prerequisite: ECE 308
Typically offered in Fall only

ECE 456/ECE 556 Mechatronics (3 credit hours)
The study of electro-mechanical systems controlled by microcomputer technology. The theory, design and construction of smart systems; closely coupled and fully integrated products and systems. The synergistic integration of mechanisms, materials, sensors, interfaces, actuators, microcomputers, controllers, and information technology.

Prerequisite: ECE 308
Typically offered in Fall only

ECE 460/ECE 560 Embedded System Architectures (3 credit hours)
Concepts of architectures for embedded computing systems. Emphasis on hands-on implementation. CPU scheduling approaches to support multithreaded programs, including interrupts, cooperative schedulers, state machines, and preemptive scheduler (real-time kernel). Communication and synchronization between threads. Basic real-time analysis. Using hardware peripherals to replace software. Architectures and design patterns for digital control, streaming data, message parsing, user interfaces, low power, low energy, and dependability. Software engineering concepts for embedded systems. Students may not receive credit for both ECE 460 and ECE 560.

Prerequisite: C- or better in ECE 306
Typically offered in Fall only

ECE 461/ECE 561 Embedded System Design (3 credit hours)
Design and implementation of software for embedded computer systems. The students will learn to design systems using microcontrollers, C and assembly programming, real-time methods,Â computerÂ architecture, interfacing system development and communication networks.Â System performance is measured in terms of power consumption, speed and reliability. Efficient methods for project development and testing are emphasized. Credit will not be awarded for both ECE 461 and ECE 561. Restricted to CPE and EE Majors.

Prerequisite: Grade of C- or better in ECE 460
Typically offered in Spring only

ECE 463/ECE 563 Microprocessor Architecture (3 credit hours)
Architecture of microprocessors. Measuring performance. Instruction-set architectures. Memory hierarchies, including caches, prefetching, program transformations for optimizing caches, and virtual memory. Processor architecture, including pipelining, hazards, branch prediction, static and dynamic scheduling, instruction-level parallelism, superscalar, and VLIW. Major projects.

Prerequisite: ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 464/ECE 564 ASIC and FPGA Design with Verilog (3 credit hours)
Design of digital application specific integrated circuits (ASICs) and Field Programmable Gate Arrays (FPGAs) based on hardware description languages (Verilog) and CAD tools. Emphasis on design practices and underlying methods. Introduction to ASIC specific design issues including verification, design for test, low power design and interfacing with memories. Required design project. Expected Prior Experience or Background: ECE 310 is useful but not assumed. Functionally, I assume that students are familiar with logic design, including combinational logic gates, sequential logic gates, timing design, Finite State Machines, etc.

P: Grade of C or better in ECE 212 or equivalent.
Typically offered in Fall only

ECE 465/ECE 565 Operating Systems Design (3 credit hours)
The course explores basic concepts and mechanisms related to the design of modern operating systems, including: process scheduling and coordination, memory management, synchronization, storage, file systems, security and protection, and their application to multi-core and many-core processors. The course involves coding projects requiring strong C programming skills.

Prerequisite: ECE306 or CSC246; ECE309; Restrictions: ECE465, ECE565 and CSC501 are mutually exclusive: students may not receive credit for both ECE465 and ECE565, or both ECE465 and CSC501, or both ECE565 and CSC501
Typically offered in Fall only

ECE 466/ECE 566 Compiler Optimization and Scheduling (3 credit hours)
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Introduce basic concepts in scanning and parsing. Investigate in depth program representation, dataflow analysis, scalar optimization, memory disambiguation, and interprocedural optimizations. Examine hardware/software tade-offs in the design of high performance processors, in particular VLIW versus dynamically scheduled architectures. Investigate back-end code generation techniques related to instruction selection, instruction scheduling for local, cyclic and global acyclic code, and register allocation and its interactions with scheduling and optimization.

Prerequisites: ECE 209 or competency in any machine language programming and ECE 309 or CSC 316 or proficiency in either C or C++ programming using advanced data structures, like hash tables and linked lists.P: ECE 209 or competency in an
Typically offered in Spring only

ECE 468/CHE 468/CHE 568/ECE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

ECE 470 Internetworking (3 credit hours)
Introduction, Planning and Managing networking projects, networking elements-hardware, software, protocols, applications; TCP/IP, ATM, LAN emulation. Design and implementation of networks, measuring and assuring network and application performance;metrics, tools, quality of service. Network-based applications, Network management and security.

Prerequisite: ECE 407 or CSC 401
Typically offered in Spring only

ECE 482/MAE 482 Engineering Entrepreneurship and New Product Development I (3 credit hours)
Applications of engineering, mathematics, basic sciences, finance, and business to the design and development of prototype engineering products. This course requires a complete written report and an end-of-course presentation. This is the first course in a two semester sequence. Students taking this course will implement their designed prototype in ECE 483: Senior Design Project in Electrical Engineering and Computer Engineering II-Engineering Entrepreneurs. Departmental approval required.

Typically offered in Fall and Spring

ECE 483/MAE 483 Engineering Entrepreneurship and New Product Development II (3 credit hours)
Applications of engineering, science, management and entrepreneurship to the design, development and prototyping of new product ideas. Based on their own new product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as 'virtual' startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the university that agree to participate as eTeam members. Departmental approval required.

Prerequisite: ECE 482
Typically offered in Fall and Spring

ECE 484 Electrical and Computer Engineering Senior Design I (3 credit hours)
Applications of engineering and basic sciences to the total design of electrical and/or computer engineering circuits and systems. Consideration of the design process including concept and feasibility study, systems design, detailed design, project management, cost-effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Supported with an introduction of key factors impacting the engineering design process including industrial design, finance, operations, etc. EE and CPE Majors only.

CPE major: Prerequisites: (ECE301 or ECE302) and (two of ECE306, ECE309, ECE310); Corequisite: One CPE Elective; EE major: Prerequisites: ECE301 and ECE302 and (one of ECE 303, E 304, ECE 305, 306, 308, 310); Corequisite: One EE Elective.
Typically offered in Fall only

ECE 485 Electrical and Computer Engineering Senior Design II (3 credit hours)
Applications of engineering and basic sciences to the total design of electrical engineering circuits and systems. Consideration of the design process including feasibility study, preliminary design detail, cost-effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Complete written and oral engineering report required. EE and CPE majors only.

Prerequisite: ECE 484
Typically offered in Spring only

ECE 488/PB 588/ECE 588/PB 488 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only

ECE 489/ECE 589/MSE 489/MSE 589/PY 489/PY 589 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

ECE 492 Special Topics in Electrical and Computer Engineering (1-4 credit hours)
Offered as needed for development of new courses in electrical and computer engineering.

Typically offered in Fall and Spring

ECE 495 Individual Study in ECE (1-3 credit hours)
Independent investigation of a topic or research problem under faculty supervision. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

P: Appropriate 300-level Course; R: EE and CPE Majors Only. Department Approval Required
Typically offered in Fall, Spring, and Summer

ECE 498 Special Projects in ECE (1-3 credit hours)
Faculty-supervised special projects in electrical and/or computer engineering. Projects involve small groups of students, working collaboratively or independently, focused on a single theme, such as the design of a component or system. Requires a "Course Agreement for Students Enrolled in Non-Standard Courses," completed by the student and faculty member prior to registration by the department.

Prerequisite: At least one 300-level ECE course, 3.0 GPA; Restricted to: EE or CPE majors
Typically offered in Fall, Spring, and Summer

ECE 505 Neural Interface Engineering (3 credit hours)
This course investigates the engineering techniques to understand, repair, replace, or enhance neural systems. The topics to be covered includes the following: the history of bioelectricity phenomena, the basics of modern neuroscience in electrical engineering terms and models, design of functional electrical interfaces with the nervous system for stimulating and recording purposes, basics of electrochemistry development of various systems for neuroprosthetics and neurorobotics applications such as pacemakers, cochlear implants and neuroprosthetic limbs.

Senior or graduate standing.
Typically offered in Fall only

ECE 506/ECE 406/CSC 406/CSC 506 Architecture Of Parallel Computers (3 credit hours)
The need for parallel and massively parallel computers. Taxonomy of parallel computer architecture, and programming models for parallel architectures. Example parallel algorithms. Shared-memory vs. distributed-memory architectures. Correctness and performance issues. Cache coherence and memory consistency. Bus-based and scalable directory-based multiprocessors. Interconnection-network topologies and switch design. Brief overview of advanced topics such as multiprocessor prefetching and speculative parallel execution. Credit is not allowed for more than one course in this set: ECE 406, ECE 506, CSC 406.

Typically offered in Fall, Spring, and Summer

ECE 511 Analog Electronics (3 credit hours)
Analog integrated circuits and analog integrated circuit design techniques. Review of basic device and technology issues Comprehensive coverage of MOS and Bipolar operational amplifiers. Brief coverage of analog-to-digital conversion techniques and switched-capacitor filters. Strong emphasis on use of computer modeling and simulation as design tool. Students required to complete an independent design project.

Prerequisite: ECE403
Typically offered in Fall only

ECE 513 Digital Signal Processing (3 credit hours)
Digital processing of analog signals. Offline and real-time processing for parameter, waveshape and spectrum estimation. Digital filtering and applications in speech, sonar, radar, data processing and two-dimensional filtering and image processing.

Prerequisite: ECE 421, B average in ECE and MA; Signals and Linear Systems
Typically offered in Fall only

ECE 514 Random Processes (3 credit hours)
Probabilistic descriptions of signals and noise, including joint, marginal and conditional densities, autocorrelation, cross-correlation and power spectral density. Linear and nonlinear transformations. Linear least-squares estimation. Signal detection.

Prerequisite: Statistics 371; Signals and Linear Systems; Linear Algebra; Calculus
Typically offered in Fall only

ECE 515 Digital Communications (3 credit hours)
This course is a first graduate-level course in digital communications. Functions and interdependence of various components of digital communication systems will be discussed. Statistical channel modeling, modulation and demodulation techniques, optimal receiver design, performance analysis methods, source coding, quantization, and fundamentals of information theory will be covered in this course.

Prerequisite: ECE 514, ST 371, Signals and Linear Systems; Linear Algebra
Typically offered in Spring and Summer

ECE 516 System Control Engineering (3 credit hours)
Introduction to analysis and design of continuous and discrete-time dynamical control systems. Emphasis on linear, single-input, single-output systems using state variable and transfer function methods. Open and closed-loop representation; analog and digital simulation; time and frequency response; stability by Routh-Hurwitz, Nyquist and Liapunov methods; performance specifications; cascade and state variable compensation. Assignments utilize computer-aided analysis and design programs.

Prerequisite: ECE 435 or ECE 301
Typically offered in Spring only

ECE 517/CSC 517 Object-Oriented Design and Development (3 credit hours)
The design of object-oriented systems, using principles such as the GRASP principles, and methodologies such as CRC cards and the Unified Modeling Language (ULM). Requirements analysis. Design patterns Agile Methods. Static vs. dynamic typing. Metaprogramming. Open-source development practices and tools. Test-first development. Project required, involving contributions to an open-source software project.

Prerequisite: CSC 326 or ECE 309
Typically offered in Fall and Spring

ECE 518/ECE 418/BME 418/BME 518 Wearable Biosensors and Microsystems (3 credit hours)
This course surveys the methods and application of wearable electronics and microsystems to monitor human biometrics, physiology, and environmental conditions. Topics covered include wearable electrocardiograms, blood-glucose monitors, electronic tattoos, wearable energy harvesting, "smart" clothing, body area networks, and distributed population networks. Critical comparison of different sensor modalities, quantitative metrics, and how their limitations in realistic applications define the selection, design, and operation criteria of one type of sensor over another will be considered.

Prerequisite: Senior standing
Typically offered in Fall only

ECE 522/BME 522 Medical Instrumentation (3 credit hours)
Fundamentals of medical instrumentation systems, sensors, and biomedical signal processing. Example instruments for cardiovascular and respiratory assessment. Clinical laboratory measurements, theraputic and prosthetic devices, and electrical safetyrequirements. Students should have background in electronics design using operational amplifiers.

Typically offered in Spring only

ECE 523 Photonics and Optical Communications (3 credit hours)
This course investigates photonic devices at the component level and examines the generation, propagation and detection of light in the context of optical communication systems. Topics include planar and cylindrical optical waveguides, LEDs, lasers,optical amplifiers, integrated optical and photodetectors, design tradeoffs for optical systems, passive optical networks, and wavelength division multiplexed systems.

Prerequisite: Graduate standing or Senior standing ; Engineering Majors or Physics Majors
Typically offered in Spring only

ECE 524/ECE 424 Radio System Design (3 credit hours)
Introduction to communication theory and radio system design. Design and analysis of radio systems, such as heterodyne transceivers, and effects of noise and nonlinearity. Design and analysis of radio circuits: amplifiers, filters, mixers, baluns and other transmission line and discrete circuits.

Prerequisite: ECE 302
Typically offered in Spring only

ECE 530 Physical Electronics (3 credit hours)
Properties of charged particles under influence of fields and in solid materials. Quantum mechanics, particle statistics, semi-conductor properties, fundamental particle transport properties, p-n junctions.

Prerequisite: ECE 303, B average in ECE and MA
Typically offered in Fall only

ECE 531 Principles Of Transistor Devices (3 credit hours)
Analysis of operating principles of transistor structures. Basic semi-conductor physics reviewed and used to provide explanation of transistor characteristics. Development and usage of device-equivalent circuits to interpret semi-conductor-imposed limitations on device performance. Devices analyzed include MISFIT'S, HEMT'S, Bipolar transistors, PBT'S, heterojunction BJT'S and SIT's.

Prerequisite: ECE 404
Typically offered in Fall only

ECE 532 Principles Of Microwave Circuits (3 credit hours)
Principles required to understand behavior of electronic circuits operating at microwave frequencies. Review of elector-magnetic theory and establishing an understanding of techniques required for working with electronic circuits at microwave and millimeter-wave frequencies. Discussion of circuit components operating at these frequencies.

Prerequisite: ECE 422
Typically offered in Spring only

ECE 533 Power Electronics Design & Packaging (3 credit hours)
This course introduces design of high-performance power electronic circuits where the integrated physical topology must be considered as part of the circuit, and provides an understanding of the multitude of parasitic elements created by circuit layout, materials and fabrication techniques. This prepares the student for high-density, high-frequency design of converters, gate drive circuits and resonant topologies. The student is also introduced to a power-electronics packaging lab and primary fabrication processes, such as Direct Bonded Copper (DBC) module construction with heavy-wire bonding, two-sided and 3D power modules in layered polymers, and high-voltage isolation of circuits with encapsulate in modules.

Prerequisite: ECE 434 or with permission of instructor
Typically offered in Spring only

ECE 534 Power Electronics (3 credit hours)
DC and AC analysis of isolated and non-isolated switch mode power supply. Basic converter topologies covered include: buck, boost and buck/boost and their transformer-couples derivatives. Design of close loop of these DC/DC converters. Power devices and their applications in DC/DC converters. Inductor and transformer design.

Prerequisite: ECE 302
Typically offered in Fall only

ECE 535/MAE 535 Design of Electromechanical Systems (3 credit hours)
A practical introduction to electromechanical systems with emphasis on modeling, analysis, design, and control techniques. Provides theory and practical tools for the design of electric machines (standard motors, linear actuators, magnetic bearings, etc). Involves some self-directed laboratory work and culuminates in an industrial design project. Topics include Maxwell's equations, electromechanical energy conversion, finite element analysis, design and control techniques.

Prerequisite: MA 341
Typically offered in Spring and Summer

ECE 536 Digital Control System Projects (3 credit hours)
Discrete system dynamics, sampled-data systems, mathematical representations of analog/digital and digital/analog conversions, open- and -closed-loop systems, input-output relationships, state-space and stability analyses, time and frequency domain analysis with emphasis on time domain. Design and implementation of digital controllers. Case studies. Design project including hardware implementation.

Prerequisite: Graduate standing & ECE 436 or similar or consent of instructor
Typically offered in Fall only

ECE 538 Integrated Circuits Technology and Fabrication (3 credit hours)
Processes used in fabrication of modern integrated circuits. Process steps for crystal growth, oxidation, diffusion, ion implantation, lithography, chemical vapor deposition, etching, metallization, layout and packaging. Process integration for MOS and biopolar processes. Characterization techniques, simulation, yield and reliability.

Prerequisite: ECE 404
Typically offered in Fall only

ECE 540 Electromagnetic Fields (3 credit hours)
Brief review of Maxwell's Equations, constitutive relations and boundary conditions. Reflection and refraction of plane waves; power and energy relations in isotropic media. Potential functions, Green's functions and their applications to radiation and scattering. Antenna fundamentals: linear antennas, uniform linear arrays and aperture antennas, microstrip antennas. Fundamentals of numerical methods for electromagnetic simulation and antenna design.

Prerequisite: ECE 422
Typically offered in Spring only

ECE 541 Antennas and Arrays (3 credit hours)
This course introduces theoretical and practical concepts for antennas and arrays. Students will learn antenna fundamentals and basic parameters, the relationships between radiation and vector potentials, and apply key electromagnetic theorems such as image theory and equivalence principle. The theory and design of linear antennas, aperture antennas, microstrip antennas are discussed. Radiation pattern control via phased arrays, reflectarrays, and periodic structures are studied. Students will learn CAD tools for electromagnetic design. This course assumes familiarity with Maxwell's equations, electromagnetic waves, electromagnetic theorems, and transmission line theory.

Prerequisite: ECE 422 or equivalent
Typically offered in Spring only

ECE 542 Neural Networks (3 credit hours)
Introduction to neural networks and other basic machine learning methods including radial basis functions, kernel methods, support vector machines. The course introduces regularization theory and principle component analysis. The relationships to filtering, pattern recognition and estimation theory are emphasized.

Typically offered in Fall and Spring

ECE 544 Design Of Electronic Packaging and Interconnects (3 credit hours)
A study of the design of digital and mixed signal interconnect and packaging. Topics covered include: Single chip (surface mount and through-hole) and multi-chip module packaging thecnology; packaging techology selection; thermal design; electricaldesign of printed circuit board, backplane and multi-chip module interconnect; receiver and driver selection; EMI control; CAD tools; and measurement issues.

Prerequisite: ECE 302
Typically offered in Spring only

ECE 546 VLSI Systems Design (3 credit hours)
Digital systems design in CMOS VLSI technology: CMOS devise physics, fabrication, primitive components, design and layout methodology, integrated system architectures, timing, testing future trends of VLSI technology.

Prerequisite: ECE 302
Typically offered in Spring only

ECE 547/CSC 547 Cloud Computing Technology (3 credit hours)
Study of cloud computing principles, architectures, and actual implementations. Students will learn how to critically evaluate cloud solutions, how to construct and secure a private cloud computing environment based on open source solutions, and how to federate it with external clouds. Performance, security, cost, usability, and utility of cloud computing solutions will be studied both theoretically and in hands-on exercises. Hardware-, infrastructure-, platform-, software-, security-, - "as-a-service".

Prerequisites: CSC 501 and either ECE/CSC 570 or ECE/CSC 573
Typically offered in Spring only

ECE 549 RF Design for Wireless (3 credit hours)
Design of the hardware aspects of wireless systems with principle emphasis on design of radio frequency (RF) and microwave circuitry. Introduction of system concepts then functional block design of a wireless system. RF and microwave transistors, noise, power ampliefiers, CAE, linearization and antennas.

Prerequisite: ECE 303, ECE 302
Typically offered in Fall only

ECE 550 Power System Operation and Control (3 credit hours)
Fundamental concepts of economic operation and control of power systems. Real and reactive power balance. System components, characteristics and operation. Steady state and dynamic analysis of interconnected systems. Tieline power and load-frequencycontrol with integrated economic dispatch.

Prerequisite: ECE 305, ECE 435
Typically offered in Fall only

ECE 551 Smart Electric Power Distribution Systems (3 credit hours)
Features and components of electric power distribution systems, power flow, short circuit and reliability analysis, basic control and protection, communications and SCADA, new "smart" functionality such as integrated volt/var control, automated fault location isolation and restoration, demand response and advanced metering infrastructure, integration of distributed generation and energy storage.

Prerequisite: ECE 451
Typically offered in Spring only

ECE 552/ECE 452 Renewable Electric Energy Systems (3 credit hours)
Principles and characteristics of renewable energy based electric power generation technologies such as photovoltaic systems, wind turbines, and fuel cells. Main system design issues. Integration of these energy sources into the power grid. Economics of distributed generation. Credit is not allowed for both ECE 452 and ECE 552.

Prerequisite: ECE 305 or ECE 331
Typically offered in Spring only

ECE 553 Semiconductor Power Devices (3 credit hours)
The operational physics and design concepts for power semiconductor devices. Relevant transport properties of semiconductors. Design of breakdown voltage and edge terminations. Analysis of Schottky rectifiers, P-i-N rectifiers, Power MOSFETs, Bipolar Transistors, Thyristors and Insulated Gate Bipolar Transistors.

Prerequisite: ECE 404
Typically offered in Fall only

ECE 554 Electric Motor Drives (3 credit hours)
Topics covered in this course: Principles of Electromechanical energy conversion; analysis, modeling and control of electric machinery; steady state performance characteristics of direct current, induction, synchronous and reluctance machines; scalar control of induction machines; introduction to direct and quadrature axis theory; dynamic models of induction and synchronous machines; vector control of induction and synchronous machines.

Prerequisite: ECE 305 or equivalent
Typically offered in Spring only

ECE 555 Computer Control of Robots (3 credit hours)
An introduction to robotics: history and background, design, industrial applications and usage. Manipulator sensors, actuators and control, linear, non-linear, and force control. Manipulator kinematics: position and orientation, frame assignment, transformations, forward and inverse kinematics. Jacobian: velocities and static forces. Manipulator Kinetics: velocity, acceleration, force. Trajectory generation. Programming languages: manipulator level, task level, and object level. Introduction to advanced robotics. Credit not allowed for both ECE 455 and 555.

Prerequisite: ECE 435; ECE 436; ECE 456
Typically offered in Spring only

ECE 556/ECE 456 Mechatronics (3 credit hours)
The study of electro-mechanical systems controlled by microcomputer technology. The theory, design and construction of smart systems; closely coupled and fully integrated products and systems. The synergistic integration of mechanisms, materials, sensors, interfaces, actuators, microcomputers, controllers, and information technology.

Prerequisite: ECE 308
Typically offered in Fall only

ECE 557 Principles Of MOS Transistors (3 credit hours)
MOS capacitor and transistor regions of operation. Depletion and enhancement mode MOSFETs. MOSFET scaling, short and narrow channel effects. MOSFETs with ion-implanted channels. High field effects in MOSFETs with emphasis on recent advances in design of hit carrier suppressed structures. Small and large signal MOSFET models. State of the art in MOS process integration.

Prerequisite: ECE 404
Typically offered in Fall only

ECE 558 Digital Imaging Systems (3 credit hours)
Foundation for designing and using digital devices to accurately capture and display color images, spatial sampling, frequency analysis, quantization and noise characterization of images. Basics of color science are presented and applied to image capture and output devices.

Prerequisites: ECE 301 and ST 372
Typically offered in Fall only

ECE 560/ECE 460 Embedded System Architectures (3 credit hours)
Concepts of architectures for embedded computing systems. Emphasis on hands-on implementation. CPU scheduling approaches to support multithreaded programs, including interrupts, cooperative schedulers, state machines, and preemptive scheduler (real-time kernel). Communication and synchronization between threads. Basic real-time analysis. Using hardware peripherals to replace software. Architectures and design patterns for digital control, streaming data, message parsing, user interfaces, low power, low energy, and dependability. Software engineering concepts for embedded systems. Students may not receive credit for both ECE 460 and ECE 560.

Prerequisite: C- or better in ECE 306
Typically offered in Fall only

ECE 561/ECE 461 Embedded System Design (3 credit hours)
Design and implementation of software for embedded computer systems. The students will learn to design systems using microcontrollers, C and assembly programming, real-time methods,Â computerÂ architecture, interfacing system development and communication networks.Â System performance is measured in terms of power consumption, speed and reliability. Efficient methods for project development and testing are emphasized. Credit will not be awarded for both ECE 461 and ECE 561. Restricted to CPE and EE Majors.

Prerequisite: Grade of C- or better in ECE 460
Typically offered in Spring only

ECE 563/ECE 463 Microprocessor Architecture (3 credit hours)
Architecture of microprocessors. Measuring performance. Instruction-set architectures. Memory hierarchies, including caches, prefetching, program transformations for optimizing caches, and virtual memory. Processor architecture, including pipelining, hazards, branch prediction, static and dynamic scheduling, instruction-level parallelism, superscalar, and VLIW. Major projects.

Prerequisite: ECE 209 and ECE 212
Typically offered in Fall and Spring

ECE 564/ECE 464 ASIC and FPGA Design with Verilog (3 credit hours)
Design of digital application specific integrated circuits (ASICs) and Field Programmable Gate Arrays (FPGAs) based on hardware description languages (Verilog) and CAD tools. Emphasis on design practices and underlying methods. Introduction to ASIC specific design issues including verification, design for test, low power design and interfacing with memories. Required design project. Expected Prior Experience or Background: ECE 310 is useful but not assumed. Functionally, I assume that students are familiar with logic design, including combinational logic gates, sequential logic gates, timing design, Finite State Machines, etc.

P: Grade of C or better in ECE 212 or equivalent.
Typically offered in Fall and Summer

ECE 565/ECE 465 Operating Systems Design (3 credit hours)
The course explores basic concepts and mechanisms related to the design of modern operating systems, including: process scheduling and coordination, memory management, synchronization, storage, file systems, security and protection, and their application to multi-core and many-core processors. The course involves coding projects requiring strong C programming skills.

Prerequisite: ECE306 or CSC246; ECE309; Restrictions: ECE465, ECE565 and CSC501 are mutually exclusive: students may not receive credit for both ECE465 and ECE565, or both ECE465 and CSC501, or both ECE565 and CSC501
Typically offered in Fall only

ECE 566/ECE 466 Compiler Optimization and Scheduling (3 credit hours)
Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Introduce basic concepts in scanning and parsing. Investigate in depth program representation, dataflow analysis, scalar optimization, memory disambiguation, and interprocedural optimizations. Examine hardware/software tade-offs in the design of high performance processors, in particular VLIW versus dynamically scheduled architectures. Investigate back-end code generation techniques related to instruction selection, instruction scheduling for local, cyclic and global acyclic code, and register allocation and its interactions with scheduling and optimization.

Prerequisites: ECE 209 or competency in any machine language programming and ECE 309 or CSC 316 or proficiency in either C or C++ programming using advanced data structures, like hash tables and linked lists.P: ECE 209 or competency in an
Typically offered in Spring only

ECE 568/ECE 468/CHE 468/CHE 568 Conventional and Emerging Nanomanufacturing Techniques and Their Applications in Nanosystems (3 credit hours)
Conventional and emerging nano-manufacturing techniques and their applications in the fabrication of various structures and devices. Review of techniques for patterning, deposition, and etching of thin films including emerging techniques such as an imprint and soft lithography and other unconventional techniques. Electronic and mechanical properties of 0 to 3-D nanostructures and their applications in nano-electronics, MEMS/NEMS devices, sensing, energy harvesting, storage, flexible electronics and nano-medicine. Credit for both ECE/CHE 468 and ECE/CHE 568 is not allowed.

Prerequisite: E 304
Typically offered in Fall only

ECE 570/CSC 570 Computer Networks (3 credit hours)
General introduction to computer networks. Discussion of protocol principles, local area and wide area networking, OSI stack, TCP/IP and quality of service principles. Detailed discussion of topics in medium access control, error control coding, and flow control mechanisms. Introduction to networking simulation, security, wireless and optical networking.

Prerequisite: ECE 206 or CSC 312, ST 371, CSC 258 and Senior standing or Graduate standing
Typically offered in Fall and Spring

ECE 573/CSC 573 Internet Protocols (3 credit hours)
Principles and issues underlying provision of wide area connectivity through interconnection of autonomous networks. Internet architecture and protocols today and likely evolution in future. Case studies of particular protocols to demonstrate how fundamental principles applied in practice. Selected examples of networked clinet/server applications to motivate the functional requirements of internetworking. Project required.

Prerequisite: CSC/ECE 570
Typically offered in Fall, Spring, and Summer

ECE 574/CSC 574 Computer and Network Security (3 credit hours)
This course presents foundational concepts of computer and network security and privacy. It covers a wide breadth of concepts, including; Fundamentals of computer security and privacy, including security models, policies, and mechanisms; Cryptography for secure systems, including symmetric and asymmetric ciphers, hash functions, and integrity mechanisms; Authentication of users and computers; Network attacks and defenses at the network and application layers; Common software vulnerabilities and mitigation strategies; Secure operating systems and seminal access control models and policies; Principles of intrusion detection; Privacy, including considerations of end-user technologies.

Prerequisite: (CSC 316 or ECE309) and (CSC 401 or ECE407) or equivalent
Typically offered in Fall and Spring

ECE 575/CSC 575 Introduction to Wireless Networking (3 credit hours)
Introduction to cellular communications, wireless local area networks, ad-hoc and IP infrastructures. Topics include: cellular networks, mobility mannagement, connection admission control algorithms, mobility models, wireless IP networks, ad-hoc routing, sensor networks, quality of service, and wireless security.

Prerequisite: ECE/CSC 570
Typically offered in Spring only

ECE 576/CSC 576 Networking Services: QoS, Signaling, Processes (3 credit hours)
Topics related to networking services, signaling for setting up networking services, such as SIP and IMS, networking architectures for providing QoS for networking services, such as MPLS, DiffServ and RAC, signaling protocols for setting up QoS connections in the transport stratum, such as LDP and RSVP-TE, video-based communications, and capacity planning models for dimensioning services.

Prerequisite: CSC/ECE 570
Typically offered in Fall and Spring

ECE 577/CSC 577 Switched Network Management (3 credit hours)
Topics related to design and management of campus enterprise networks, including VLAN design; virtualization and automation methodologies for management; laboratory use of open space source and commercial tools for managing such networks.

Typically offered in Fall only

ECE 578 LTE and 5G Communications (3 credit hours)
The course provides an introduction to the theoretical fundamentals and practical/experimental aspects of Long Term Evolution (LTE) and 5G systems. A basic understanding of digital communications and radio access networks is required. Following topics will be studied: 1) User and control plane protocols, 2) physical layer for downlink, 3) physical layer for uplink, 4) practical deployment aspects, 5) LTE-Advanced, 6) 5G communications. Fundamental concepts to be covered in the context of LTE/5G systems include OFDMA/SC-FDMA, synchronization, channel estimation, link adaptation, MIMO, scheduling, and millimeter wave systems. Students are recommended to have the prior knowledge gained from ECE 570 or ECE 582 before taking this course. The course will also require using Matlab software for homeworks, including its LTE and 5G toolboxes.

Typically offered in Fall only

ECE 579/OR 579/CSC 579 Introduction to Computer Performance Modeling (3 credit hours)
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

ECE 581 Electric Power System Protection (3 credit hours)
Protection systems used to protect the equipment in an electric power system against faults, fault analysis methods, basic switchgear used for protection, basic protection schemes, such as overcurrent, differential, and distance protection and their application.

Prerequisite: ECE 451
Typically offered in Spring only

ECE 582 Wireless Communication Systems (3 credit hours)
Theory and analysis of wireless portable communication systems. Provides a fundamental understanding of the unique characteristics of these systems. Topics include: Code Division Multiple Access (CDMA), mobile radio propagation, characterization of a Rayleigh fading multipathchannel, diversity techniques, adaptive equalization, channel coding, and modulation/demodulation techniques. Although contemporary cellular and personal communication services(PCS) standards are covered, the course stresses fundamental theoretical concepts that are not tied to a particular standard.

Prerequisite: Senior level digital communications course, e.g., ECE402, Corequisite: ECE 714
Typically offered in Fall only

ECE 583 Electric Power Engineering Practicum I (3 credit hours)
This course introduces fundamentals of project management and system engineering principles in a wide range of electric power applications from concept through termination. The course also provides opportunities for students to adapt technical content to both expert and novice audiences in project management reports and presentations. Restricted to Master of Science in Electric Power Systems Engineering.

Prerequisite: ECE 451
Typically offered in Spring only

ECE 584 Electric Power Engineering Practicum II (3 credit hours)
In this capstone course students will apply electric engineering and science knowledge to an electrical power engineering project. Consideration of the design process including feasibility study, preliminary design detail, cost effectiveness, along with development and evaluation of a prototype accomplished through design-team project activity. Complete written and oral engineering report required. Restricted to Master of Science in Electric Power Systems Engineering.

Prerequisite: ECE 583
Typically offered in Fall and Summer

ECE 585 The Business of the Electric Utility Industry (3 credit hours)
Evolution of the electric utility industry, the structure and business models of the industry, the regulatory factors within which the utilities operate, the operations of the utility industry and the current policy and emerging technology issues facing the business. The course includes significant interaction with industry officials and utility business operations.

Prerequisite: ECE 451
Typically offered in Fall only

ECE 586 Communication and SCADA Systems for Smart Grid (3 credit hours)
This is an introductory course on communication technologies and SCADA (supervisory control and data acquisition) systems for smart electric power applications. The fundamental concepts, principles, and practice of how communication systems operate are introduced and the function of main components reviewed. Application of communication systems for electric power, in particular SCADA architecture and protocols are also introduced. The course includes hands-on experience with typical intelligent electronic devices interconnected by a communication system.

R: Graduate Students Only
Typically offered in Fall only

ECE 587 Power System Transients Analysis (3 credit hours)
Review of solutions to first and second order differential equations for electric power circuit transients. Applications to fault current instantaneous, shunt capacitor transients, circuit switching transients and overvoltages, current interruption and transformer transient behavior. Computer solution techniques for transient analysis using PSCAD and Matlab/Simulink. Modeling of utility power electronics circuits including single and three-phase rectifiers and inverters. Applications of power electronics for transmission system control and renewable generation. Distributed line modeling for traveling wave analysis of surge events. Introduction to voltage insulation, surge arrestor operation and lightning stroke analysis.

Typically offered in Fall only

ECE 588/PB 488/ECE 488/PB 588 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only

ECE 589/MSE 489/MSE 589/PY 489/PY 589/ECE 489 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

ECE 591 Special Topics In Electrical Engineering (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 592 Special Topics In Electrical Engineering (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 600 ECE Graduate Orientation (1 credit hours)
Introduction of the Electrical and Computer Engineering Department graduate program. Introduction to computing and library facilities; Review of NC State student code of conduct and ethics. Structure of the ECE department. General information for starting graduate studies. Overview of on-going research projects by faculty members. Must hold graduate standing.

Typically offered in Fall and Spring

ECE 633 Individual Topics In Electrical Engineering (1-3 credit hours)
Provision of opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 634 Individual Studies In Electrical Engineering (1-3 credit hours)
The study of advanced topics of special interest to individual students under direction of faculty members.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECE 650 Internship (3 credit hours)
This course requires an internship with a company or organization outside the University. The student will secure an internship of a technical nature and complete and submit a Coop report for evaluation.

Restricted: 14EEMS, 14CPEMS, 14CNEMS, 14EPSEMS
Typically offered in Fall and Spring

ECE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

ECE 690 Master's Exam (1-9 credit hours)

ECE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ECE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall and Spring

ECE 705 Memory Systems (3 credit hours)
Covers recent research on overcoming the problem of memory access and memory speed, two major limitations on the speed of computers. Overview of the current state of memory technologies, novel cache structures and management techniques, prefetching,memory compression, and parallelism at the instruction and thread levels. Research papers required.

Prerequisite: ECE 521, Computer Design and Technology

ECE 706 Advanced Parallel Computer Architecture (3 credit hours)
Advanced topics in parallel computer architecture. Hardware mechanisms for scalable cache coherence, synchronization, and speculation. Scalable systems and interconnection networks. Design or research project required.

Prerequisite: ECE/CSC 506, ECE 521
Typically offered in Spring only

ECE 712 Integrated Circuit Design for Wireless Communications (3 credit hours)
Analysis, simulation, and design of the key building blocks of an integrated radio: amplifiers, mixers, and oscillators. Topics include detailed noise optimization and linearity performance of high frequency integrated circuits for receivers and transmitters. Introduction to several important topics of radio design such as phase-locked loops, filters and large-signal amplifiers. Use of advanced RF integrated circuit simulation tools such as SpectreRF or ADS for class assignments.

Prerequisite: ECE 511
Typically offered in Spring only

ECE 714 Advanced Integrated Circuit Design: Data Converters (3 credit hours)
This course is a graduate level course in Analog-to-digital converters. Students will learn the fundamentals of sampling and the translation of signals form the digital to analog and analog to digital domains. Students will learn the basic circuits unique to data converters and how they impact design. Students will learn to a design digital-to-analog converter as well as 3 ADCs: Pipeline, Sigma-Delta and Successive-approximation. After completion of this course you will have the background to successfully design an ADC and DAC.

Prerequisite: ECE 511
Typically offered in Fall only

ECE 718 Computer-Aided Circuit Analysis (3 credit hours)
Steady state and transient analysis of circuits with emphasis on circuit theory and computer methods. Consideration of many analysis techniques, including linear nodal, signal flow graph, state equation, time-domain and functional simulation and analysis of sampled data systems. Sensitivity and tolerance analysis, macromodeling of large circuits and nonlinear circuit theory.

Prerequisite: ECE 511

ECE 719 Advanced Microwave Design (3 credit hours)
Development and examination of techniques used in the design of microwave and millimeter wave components and systems. Specific topics include frequency planning, system design using modules, and design of microwave amplifiers and oscillators. Design for specified frequency, noise, power, mixer or oscillator performance will be covered. There are three design projects: system planning, amplifier design, and oscillator design all using commercial microwave computer aided design tools.

Prerequisite: ECE 549
Typically offered in Spring only

ECE 720 Electronic System Level and Physical Design (3 credit hours)
Study of transaction-level modeling of digital systems-on-chip using SystemC. Simulation and analysis of performance in systems with distributed control. Synthesis of digital hardware from high-level descriptions. Physical design methodologies, including placement, routing, clock-tree insertion, timing, and power analysis. Significant project to design a core at system and physical levels. Knowledge of object-oriented programming with C and register-transfer-level design with verilog or VHDL is required.

Prerequisite: ECE 520
Typically offered in Fall only

ECE 721 Advanced Microarchitecture (3 credit hours)
Survey of advanced computer microarchitecture concepts. Modern superscalar microarchitecture, complexity-effective processors, multithreading, advanced speculation techniques, fault-tolerant microarchitectures, power and energy management, impact of new technology on microarchitecture. Students build on a complex simulator which is the basis for independent research projects.

Prerequisite: ECE 521
Typically offered in Spring only

ECE 722 Electronic Properties of Solid-State Materials (3 credit hours)
Materials and device-related electronic properties of semiconductors. Included topics: energy band structure, electrical and thermal transport phenomena, scattering processes, localized energy states, equilibrium and non-equilibrium semiconductor statistics.

Prerequisite: ECE 530
Typically offered in Spring only

ECE 723 Optical Properties Of Semiconductors (3 credit hours)
Materials and device-related properties of compound optical semiconductors. Included topics: band structure, heterojunctions and quantum wells, optical constants, waveguides and optical cavities, absorption and emission processes in semiconductors, photodetectors, light emitting diodes, semiconductor lasers.

Prerequisite: ECE 530
Typically offered in Spring only

ECE 724 Electronic Properties Of Solid-State Devices (3 credit hours)
Basic physical phenomena responsible for operation of solids-state devices. Examination and utilization of semiconductor transport equations to explain principles of device operation. Various solid-state electronics devices studied in detail.

Prerequisite: ECE 530
Typically offered in Spring only

ECE 725 Quantum Engineering (3 credit hours)
Development of advanced engineering concepts at the quantum level relevant to nanoscience, nanoelectronics, and quantum photonics. Topics include tunneling phenomena, specifics of time dependent and time independent perturbation methodology for addressing applications under consideration, including the WKB approach, and an introduction to second quantization for engineers. Applications include, but are not limited to, tunneling in a two-level system, molecular rotation through excitation, field emission, van der Waal interactions, optical absorption in quantum wells, and electron transport through model molecules.

Prerequisite: ECE 530, and PY 401
Typically offered in Spring only

ECE 726 Advanced Feedback Control (3 credit hours)
Advanced topics in dynamical systems and multivariable control. Current research and recent developments in the field.

Prerequisite: ECE 516
Typically offered in Fall only

ECE 732 Dynamics and Control of Electric Machines (3 credit hours)
Dynamic behavior of AC electric machines and drive systems; theory of field orientation and vector control for high performance induction and synchronous machines; permanent magnet and reluctance machines and their control; principles of voltage source and current source inverters, and voltage and current regulation methods.

Prerequisite: ECE 453 or ECE 592
Typically offered in Fall only

ECE 733 Digital Electronics (3 credit hours)
In-depth study of digital circuits at the transistor level. Topics include fundamentals; high speed circuit design; low-power design; RAM; digital transceivers; clock distribution; clock and data recovery; circuits based on emergining devices. Project.

Prerequisite: ECE 546
Typically offered in Fall only

ECE 734 Power Management Integrated Circuits (3 credit hours)
Review of modern power management converters and circuits; Review modeling and control of converters; Detail discussion of voltage and current mode controllers; Understanding of power converter losses and optimization method, as well as management of power; Integrated circuit design of various power management chips.

Prerequisite: ECE 511 and ECE 534
Typically offered in Spring only

ECE 735 Wide Band Gap Semiconductor Power Devices (3 credit hours)
This course provides students with an in-depth knowledge of power devices built from wide bandgap semiconductors: the design of high breakdown voltages, the physics of unique power rectifier structures suitable for SiC material, the operating principles for unique SiC power MOSFETs, and GaN HEMT devices, the development of bipolar power devices from SiC to achieve ultra-high voltage performance and the performance of wide bandgap semiconductor power devices as compared to advanced silicon devices.

Prerequisite: ECE 553 or equivalent
Typically offered in Spring only

ECE 736 Power System Stability and Control (3 credit hours)
Principles of FACTS (flexible AC transmission systems) and their applications. Power transmission on an AC system. Power system models for steady-state and dynamic analysis. Power system transient analysis for stability assessment. Voltage phenomena and methods for assessment.

Prerequisite: ECE 451 and ECE 750
Typically offered in Spring only

ECE 739 Integrated Circuits Technology and Fabrication Laboratory (3 credit hours)
An integrated circuit laboratory to serve as a companion to ECE 538. Hands-on experience in semiconductor fabrication laboratory. Topics include: techniques used to fabricate and electrically test discrete semiconductor devices, the effects of process variations on measurable parameters.

Prerequisite: ECE 538
Typically offered in Spring only

ECE 745 ASIC Verification (3 credit hours)
This course covers the verification process used in validating the functional correctness in today's complex ASICs (application specific integrated circuits). Topics include the fundamentals of simulation based functional verification, stimulus generation, results checking, coverage, debug, and formal verification. Provides the students with real world verification problems to allow them to apply what they learn.

Prerequisite: ECE 564
Typically offered in Spring only

ECE 748 Advanced Functional Verification with Universal Verification Methodology (3 credit hours)
The Universal Verification Methodology is the industry standard for functional verification of today's complex ASICs and FPGAs. Students will learn the content and use of UVM to architect and implement complex test benches. The characteristics and architecture of reusable verification components is a major focus of the course. Students will learn and implement verification components which are reusable across projects, from block level simulation to chip level simulation, and from simulation to emulation. The course projects teach and demonstrate advanced verification methodologies that prepare students for careers in functional verification of digital semiconductors.

Prerequisite: ECE 745 or equivalent
Typically offered in Fall only

ECE 751 Detection and Estimation Theory (3 credit hours)
Methods of detection and estimation theory as applied to communications, speech and image processing. Statistical description of signals and representation in time, spatial and frequency domains; Baysian methods, including Wiener, Kalman and MAP filters; performance measures; applications to both continuous and discrete systems.

Prerequisite: ECE 514, ECE 421
Typically offered in Spring only

ECE 752 Information Theory (3 credit hours)
An overview of Shannon's theory of information, which establishes fundamental limits on the performance of data compression and quantization algorithms, communication systems, and detection and estimation algorithms. Topics include information measures and their properties, information source models, lossless data compression, channel coding and capacity, information theory and statistics, and rate-distortion theory. Applications of information theory will also be discussed, including Lempel-Ziv data compression, vector quantization, error-correcting codes, satellite communications and high-speed modems.

Prerequisite: ECE 514: Random Processes

ECE 753 Computational Methods for Power Systems (3 credit hours)
This course is designed to introduce computational methods used for power grid operation and planning. The course will help students understand the various computational methods that form the basis of major commercial software packages used by grid analysts and operators. Students are expected to have some basic understanding of principles of power system analysis including power system models, power flow calculation, economic dispatch, reliable and stability analysis. The course covers the following computational methods commonly used in power grid operation and planning: Locational Marginal Pricing Schemes, Game Theory, Unconstrained Optimization, Linear Programming, Non-linear Constrained Optimization, and Forecasting Methods.

Prerequisite: ECE 451 or ECE 550
Typically offered in Spring only

ECE 755 Advanced Robotics (3 credit hours)
Advanced robotics at its highest level of abstraction; the level of synthesizing human reasoning and behavior. Advanced tobotics deals with the intelligent connection of perception to action. At this level the subject requires knowledge of sensing(computer vision, tactile, sonar), and reasoning (artifical intelligence: machine learning, planning, world modeling). The advanced robotics course will be valuable for students who wish to work in the area.

Prerequisite: ECE 555; MAE 544
Typically offered in Fall only

ECE 756 Advanced Mechatronics (3 credit hours)
A project-oriented course focusin on the design, analysis, and implementation of advanced mechatronics technologies, including large-scale distributed sensors, distributed-actuators, and distributed-controllers connected via communication networks.Will use unmanned vehicles as the project platform, with applications from sensors, actuators, network-based controllers, cameras, and microcontrollers. ECE 516 is recommended.

Prerequisite: ECE 456 or ECE 556 with a Grade B+ and above
Typically offered in Spring only

ECE 759 Pattern Recognition (3 credit hours)
Image pattern recognition techniques and computer-based methods for scene analysis, including discriminate functions, fixture extraction, classification strategies, clustering and discriminant analysis. Coverage of applications and current research results.

Prerequisite: ECE(CSC) 514, ST 371, B average in ECE and MA
Typically offered in Spring only

ECE 762 Advanced Digital Communications Systems (3 credit hours)
An advanced graduate-level course in digital communications. Topics include signal design, equalization methods and synchronization techniques for realistic communication channels. Projects concentrate on literature review and computer simulations.

Prerequisite: ECE 515 or equivalent
Typically offered in Fall only

ECE 763 Computer Vision (3 credit hours)
Analysis of images by computers. Specific attention given to analysis of the geometric features of objects in images, such as region size, connectedness and topology. Topics include: segmentation, template matching, motion analysis, boundary detection, region growing, shape representation, 3-D object recognition including graph matching.

Prerequisite: ECE 558 and ECE 514
Typically offered in Spring only

ECE 765 Probabilistic Graphical Models for Signal Processing and Computer Vision (3 credit hours)
Techniques for machine learning using probabilistic graphical models. Emphasis on Bayesian and Markov networks with applications to signal processing and computer vision.

Prerequisites: Programming experience (MATLAB, C++ or other object oriented language such as Python), linear algebra (MA 405 or equivalent), and probability (ECE 514, equivalent or instructor permission)
Typically offered in Fall only

ECE 766 Signal Processing for Communications & Networking (3 credit hours)
This course deals with the signal processing principles underlying recent advances in communications and networking. Topics include: smart-antenna and multi-input multi-output (MIMO) techniques; multiuser communication techniques (multiple access, power control, multiuser detection, and interference managment); signal processing in current and emerging network applications such as cognitive radio and social networks. Knowledge of linear alegbra and stochastic analysis is required.

Prerequisite: Graduate standing
Typically offered in Fall only

ECE 767 Error-Control Coding (3 credit hours)
An introduction to the theory and practice of codes for detecting and correcting errors in digital data communication and storage systems. Topics include linear block codes, cyclic codes, cyclic redundancy checksums, BCH and Reed-Solomon codes, convolutional codes, trellis-coded modulation, LDPC and turbo codes, Viterbi and sequential decoding, and encoder and decoder architecture. Applications include the design of computer memories, local-area networks, compact disc digital audio, NASA's deepspace network, high-speed modems, communication satellites, and cellular telephony.

Prerequisite: ECE 514 Random Processes; linear algebra at the undergraduate level is strongly recommended

ECE 773/CSC 773 Advanced Topics in Internet Protocols (3 credit hours)
Cutting-edge concepts and technologies to support internetworking in general and to optimize the performance of the TCP/IP protocol suite in particular. Challenges facing and likely evolution for next generation intenetworking technologies. This course investigates topics that include, but may be not limited to: Internet traffic measurement, characteriztion and modeling, traffic engineering, network-aware applications, quality of service, peer-to-peer systems, content-distribution networks, sensor networks, reliable multicast, and congestion control.

Prerequisite: CSC/ECE 573
Typically offered in Spring only

ECE 774/CSC 774 Advanced Network Security (3 credit hours)
A study of network security policies, models, and mechanisms. Topics include: network security models; review of cryptographic techniques; internet key management protocols; electronic payments protocols and systems; intrusion detection and correlation; broadcast authentication; group key management; security in mobile ad-hoc networks; security in sensor networks.

Prerequisite: CSC/ECE 570, CSC/ECE 574
Typically offered in Spring only

ECE 775/CSC 775 Advanced Topics in Wireless Networking (3 credit hours)
Reviews the current state of research in wireless networks, network architectures, and applications of wireless technologies; students will design, organize, and implement or simulate systems in a full-semester research project. For students with background in networking and communications who wish to explore research and development topics.

Prerequisite: ECE/CSC 575
Typically offered in Fall only

ECE 776/CSC 776 Design and Performance Evaluation of Network Systems and Services (3 credit hours)
Introduction to the design and performance evaluation of network services. Topics include top-down network design based on requirements, end-to-end services and network system architecture, service level agreements, quantitative performance evaluation techniques. Provides quantitative skills on network service traffic and workload modeling, as well as, service applications such as triple play, internet (IPTV), Peer-to-peer (P2P), voice over IP (VoIP), storage, network management, and access services.

Prerequisite: CSC(ECE) 570 and CSC(ECE) 579
Typically offered in Spring only

ECE 777/CSC 777 Telecommunications Network Design (3 credit hours)
Analytic modeling and topological design of telecommunications networks, including centralized polling networks, packet switched networks, T1 networks, concentrator location problems, routing strategies, teletraffic engineering and network reliability.

Prerequisite: CSC(ECE) 570
Typically offered in Spring only

ECE 785 Topics in Advanced Computer Design (3 credit hours)
In depth study of topics in computer design; advantages and disadvantages of various designs and design methodologies; technology shifts, trends, and constraints; hardware/software tradeoffs and co-design methodologies.

Prerequisite: ECE 520, ECE 521
Typically offered in Spring only

ECE 786 Advanced Computer Architecture: Data Parallel Processors (3 credit hours)
In-depth study of processor architectures to exploit data-level parallelism, including general computation on graphics processing units (GPGPU, aka GPU computing architecture) and vector processors; memory subsystems; advantages and disadvantages of various architectures; technology shifts, trends, and constraints.

P: ECE 463/563 and CSC/ECE 506
Typically offered in Spring only

ECE 791 Special Topics In Electrical Engineering (3-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 792 Special Topics In Electrical Engineering (1-6 credit hours)
Two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 801 Seminar in Electrical and Computer Engineering (1-3 credit hours)
Typically offered in Fall and Spring

ECE 804 Seminar in Comm/Sig PR (1-3 credit hours)
Typically offered in Fall and Spring

ECE 833 Individual Topics In Electrical Engineering (1-3 credit hours)
Provision of opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Prerequisite: B average in technical subjects
Typically offered in Fall and Spring

ECE 834 Individual Studies In Electrical Engineering (1-3 credit hours)
The study of advanced topics of special interest to individual students under direction of faculty members.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ECE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking writte and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall only

ECE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ECE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ECE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Elementary Education (ELM)

ELM 250 Introduction to Elementary Education in a Global Society (3 credit hours)
Introduction to the major conceptual and intellectual foundations of the teaching profession, the sociology and culture of elementary schools and classrooms, and the world of work of elementary teachers. Fieldwork in schools and related settings maybe required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.Students interested in Elementary Education.

Prerequisite: Sophomore standing
Typically offered in Spring and Summer

ELM 310 Children's Thinking and Additive Reasoning (3 credit hours)
Examination of mathematical reasoning processes in primary grade children and the theory and practice of active teaching strategies designed to motivate and engage children in mathematics learning in grades K-3. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 320 Teaching Science in the Primary Grades (3 credit hours)
Examination of science knowledge and thinking in primary-age children. Development and application of methods for teaching science in the primary grades that leads to active learning of science as a process of inquiry. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 330 Teaching Reading in Elementary School: K-2 (3 credit hours)
ELM 330 is designed to prepare preservice teachers to teach reading and to lead to licensure in the elementary grades. Specific topics that relate to the theory and practice of teaching reading for early and emergent readers, including literature and struggling readers, will be examined. Fieldwork in schools and related settings may be required in lieu of lecture in occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 335 Teaching Reading in the Elementary School: 3-5 (3 credit hours)
ELM 335 is designed to prepare preservice teachers to teach reading and to lead to licensure in the elementary grades. Specific topics that relate to the theory and practice of teaching reading for upper elementary grade readers, including information and media literacy and literature, will be examined. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experience.

Prerequisite: ELM 330, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 340 Children Design, Create and Invent (3 credit hours)
An active hands-on class where prospective elementary school teachers develop learning activities that children can use to stimulate their imaginations and learn fundamental concepts in science, technology, engineering, and mathematics. Part of a program leading to licensure in Elementary Education.

Prerequisite: ELM 370, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 350 Assessment of Learning and Behavior (3 credit hours)
Application of knowledge of pedagogy and development to develop high-quality strategies for formative and summative assessment. Best practices using developmentally-appropriate assessment strategies including authentic assessment, portfolios and electronic portfolios, real-time feedback, open- and closed-ended formal assessments, and standardized testing. Particular attention to examining the rationale for assessment and the implications of assessment.

Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 370 Connections Seminar I The Elementary Classroom and School Community (3 credit hours)
The purpose of this course is to introduce preservice teachers to the world of public school classrooms and school communities and to the tasks of teaching. Particular emphasis is placed on building a positive classroom climate and implementing effective classroom management strategies and routines. Weekly fieldwork in schools and related settings is requires 3 hours a week. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 250, Junior standing, Elementary Education Majors
Typically offered in Fall only

ELM 375 Connections Seminar II Cultural Identity, Social Justice and Diverse Learners (3 credit hours)
The purpose of the course is to help prospective elementary grades teachers develop the competencies to provide equitable opportunities to all of their future students. To do this, students will investigate issues of systemic injustice and the role of the school in interrupting cycles of inequality, and develop the capacity to engage in culturally relevant pedagogy. Weekly fieldwork in schools and related settings is required 3 hours a week. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 370;Junior standing. Elementary Education majors.
Typically offered in Fall only

ELM 400 Connections Seminar III Instructional Design and Assessment (3 credit hours)
In this course preservice elementary educators will examine research-verified practices in instructional design and assessment that are designed to meet the needs of diverse K-6 learners. This course will prepare candidates to plan appropriate units of study, learning experiences and assessment methods for use in the elementary classroom. Weekly fieldwork in schools and related settings is required. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 375, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 410 Children's Thinking and Multiplicative Reasoning (3 credit hours)
This course is designed to prepare preservice teachers to teach math in the intermediate grades and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching of math will be examined. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 310, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 420 Teaching Science in the Intermediate Grades (3 credit hours)
This course is designed to prepare preservice teachers to teach science in intermediate grades and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching science will be examined. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 320, Senior standing, Elementary Education Majors
Typically offered in Spring only

ELM 430 Teaching Language Arts in the Elementary School (3 credit hours)
This course is designed to prepare preservice teachers to teach language arts and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching language arts will be examined. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 335, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 440 Teaching Children with Special Needs in the Elementary Classroom (3 credit hours)
This course is designed to prepare preservice teachers to teach students with special needs and to lead to licensure in the elementary grades. Specific methodologies that relate to the theory and practice of teaching students with special needs willbe examined. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportation to and from their school based experiences.

Prerequisite: ELM 350, ELM 375, Senior standing, Elementary Education Majors, Corequisite: ELM 420
Typically offered in Fall only

ELM 450 The Arts for Elementary Education (3 credit hours)
This course is designed to prepare preservice teachers to integrate the arts; visual music, dance and drama, into the content areas. Successful completion of this course leads to licensure in the elementary grades. Specific methodologies that relateto the theory and practice of teaching the arts will be examined.

Prerequisite: ELM 375, Senior standing, Elementary Education Majors
Typically offered in Fall only

ELM 460 Social Studies for the Young Learner (3 credit hours)
This course is designed to prepare preservice teachers to teach social studies and to lead to licensure in the elementary grades. The course is an examination of curriculum, instruction, and learning in K-6 social studies education. Emphases includedevelopment of the social studies; curricular principles and components; teaching strategies; and learner outcomes. Fieldwork in schools and related settings may be required in lieu of lecture on occasion. Students are responsible for transportationto and from their school based experiences.

Prerequisite: ELM 370, Junior standing, Elementary Education Majors
Typically offered in Spring only

ELM 480 Connections Seminar IV Linking Theory and Practice (3 credit hours)
ELM 480 Linking Theory and Practice is designed as the capstone course in the Elementary Education Program. Teacher candidates will meet regularly to analyze and discuss their student teaching experiences and connect new learning to previous university coursework. In addition, teacher candidates will complete their edTPA Tasks and other culminating activities required by the program.

Prerequisite: ELM 400, Elementary Education Majors, Admission to the Professional Semester, Corequisite: ELM 484
Typically offered in Spring only

ELM 484 Student Teaching in Elementary Education (9 credit hours)
Culminating experience for Elementary Education majors. A minimum of 10 weeks of supervised teaching in an elementary school classroom, demonstrating competent applications of standards-based practices and other required knowledge, skill, and dispositional outcomes. Taken concurrently with ELM 480. Students responsible for transportation to placement site.

Prerequisite: ELM 480, ELM 400, Elementary Education Majors, Admission to the Professional Semester
Typically offered in Spring only

ELM 515 Instructional Practice in Schools I (1 credit hours)
Prepares pre-service teachers to develop competencies in assessment, instructional design, and tutoring and leads to initial licensure in the elementary grades. Includes 15-20 hours of fieldwork; transportation to schools is the responsibility of the students.

Typically offered in Fall and Spring

ELM 516 Instructional Practice in Schools II (2 credit hours)
Prepares pre-service teachers to develop competencies in assessment, instructional design, and teaching in whole class settings and leads to initial licensure in the elementary grades. Includes 30 hours of fieldwork; transportation to the schools is the responsibility of the students.

Corequisite: ELM 572, ELM 573, ELM 575
Typically offered in Fall and Spring

ELM 520 Methods of Teaching Elementary School Science (3 credit hours)
This course is intended for teachers seeking to expand their knowledge and skills in teaching elementary school science. The course examines the purposes, scope, sequences, materials, and methodologies for teaching science in elementary schools to a diverse student body. It develops skill in planning, instructing, and assessing understanding of science content and processes. It links instruction and assessment and addresses relevant content topics in chemistry, biology, physics, and earth and space science.

Typically offered in Spring only

ELM 524 Issues in Elementary School Science Education (3 credit hours)
Analysis of contemporary elementary school environments specific to elementary science content areas: life, Earth/space, and physical science in elementary school as well as science practices of argumentation, discourse, learning progressions, and science for all.

Typically offered in Spring only

ELM 530 Social Studies In the Elementary School (3 credit hours)
Advanced professional training in teaching of social studies for middle grades and elementary teachers, including in-depth introduction to research-based teaching strategies, instructional resources and literature of the field.

ELM 533 Targeted Literacy Assessment and Instruction for Elementary School (3 credit hours)
Intended for teachers seeking to expand their knowledge and skills in assessing and teaching elementary reading, particularly to students with reading difficulties. Exploring the purposes, sequences, and materials for identifying students' instructional strengths and learn methods for providing appropriate evidence-based reading instruction. Closely links reading assessment and reading instruction and addresses relevant content topics in elementary reading development, assessment, and instruction.

Typically offered in Spring only

ELM 537/ECI 537 Teaching Children's Literature (3 credit hours)
Instructions for educators in quality children's literature, specific needs of young reader, genres of children's literature, strategies for instructing children's literature, ways to target reader's interests, and design of literature units.

Typically offered in Summer only

ELM 539 Special Problems in Elementary School Science (3 credit hours)
In this course teachers build their science content knowledge in life, physical, and Earth/space science, examine strategies for effective science instruction to provide students with 21st Century skills with applications to young children's cognitive and affective learning.

Typically offered in Spring only

ELM 540 Reading In the Elementary School (3 credit hours)
Theoretical foundations of reading instruction and current methods and materials for teaching reading, with emphasis on planning and implementing reading programs for children in kindergarten through grade six.

ELM 555 Number Systems and Operations: K-5 Mathematical Tasks (3 credit hours)
Analysis and construction of effective mathematical tasks in teaching number systems and operations at the K-5 level; attention is also given to the expansion of content knowledge.

Typically offered in Fall only

ELM 556 Rational Numbers and Operations: K-5 Learning Trajectories (3 credit hours)
Focus on rational number concepts through learning trajectories at the K-5 level; attention also given to problem solving and content knowledge.

Typically offered in Spring only

ELM 557 Data Analysis and Measurement: K-5 Classroom Interactions (3 credit hours)
Focus on statistical literacy of elementary teachers and the teaching of data analysis and measurement to K-5 students; attention is also given to learning methods which facilitate appropriate classroom interactions.

Typically offered in Summer only

ELM 558 Algebraic Reasoning: K-5 Discourse and Questioning (3 credit hours)
Focus on the early algebra concepts of functional thinking and generalized arithmetic in relationship to pedagogical practices centered on questioning in the mathematics classroom.

Typically offered in Summer only

ELM 559 Geometry and Spatial Visualization: K-5 Assessment (3 credit hours)
Formative and summative assessment strategies of students' geometric thinking in elementary grades; Concept development of 2- and 3-dimensional Geometry. Attention also given to diagnosis of student errors.

Typically offered in Summer only

ELM 560 Mathematical Modeling: K-5 Leadership (3 credit hours)
Generating mathematical representations and making explicit connections between concepts; Pedagogy designed to equip elementary teachers to become mathematics teacher-leaders in school settings; Focus given to topics integrated within mathematical strands.

Typically offered in Summer only

ELM 570 The Foundations of Reading Instruction in the Elementary-School Classroom (3 credit hours)
This course serves as an introductory course for preservice teachers to develop the initial knowledge connected to the pillars of reading instruction needed to teach reading at the elementary-school level. This course builds on evidence-based perspectives on Grades K-6 reading instruction and the "science of reading," and provides candidates with the knowledge needed to teach the foundations of reading. This course serves as a prerequisite for ELM 572 ("The Structures of Reading Instruction in the Elementary-School Classroom").

R: Graduate standing and admission to the Elementary Education Master of Arts in Teaching program or English as a Second Language Master of Arts in Teaching Program, or by permission of instructor
Typically offered in Fall and Spring

ELM 571 Language Arts, New Literacies and Media for Initial License (3 credit hours)
Examine research-based processes for writing instruction, effects of and approaches for use of technology on literacy development, and effects of media and new literacies (non-print literacies, e.g. digital, visual, film) on literacy learning and development in elementary schools. Restricted to ELM MAT students.

Typically offered in Fall and Spring

ELM 572 The Structures of Reading Instruction in the Elementary-School Classroom (3 credit hours)
ELM 572 prepares pre-service teachers to teach reading and leads to licensure in the elementary grades. The course examines specific research-based methodology that relates to the theory and practice of teaching reading for elementary readers. Restricted to ELM, MAT students.

R: Graduate standing and admission to the Master of Arts in Teaching program, or by permission of instructor.; Prerequisite: ELM 570.
Typically offered in Fall and Spring

ELM 573 Methods for Teaching Elementary School Science for Initial License (3 credit hours)
ELM 573 prepares preservice teachers to teach science and leads to licensure in the elementary grades. The course examines specific research verified methodologies that relate to the theory and practice of teaching science to elementary students. Restricted to ELM MAT students.

Typically offered in Fall and Spring

ELM 574 Methods for Teaching Mathematics in the Elementary Classroom for Initial License (3 credit hours)
Prepares preservice teachers to teach mathematics and leads to licensure in the elementary grades. Examines specific research-based methodologies that relate to the theory and practice of teaching mathematics to elementary students. Limited to students enrolled in MAT Elementary Education program.

Typically offered in Fall and Spring

ELM 575 Social Studies in the Elementary School for Initial License (3 credit hours)
Designed to prepare pre-service teachers to teach social studies and to lead to licensure in the elementary grades. The course is an examination of curriculum, instruction, and learning in K-6 social studies education, Emphasis include development of the social studies, curricular principles and components, research verified teaching strategies, and learner outcomes. Restricted to ELM MAT students.

Typically offered in Fall and Spring

ELM 590 Special Problems in Elementary Education (1-6 credit hours)
In-depth study of topical problems in teaching and learning of current and special interest to elementary education practitioners.

Typically offered in Fall, Spring, and Summer

ELM 630 Independent Study in Elementary Education (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall and Spring

ELM 644 Practicum in Elementary Education (1-6 credit hours)
Supervised practical experiences in schools and area agencies concerned with education of elementary-age students.

ELM 654 Internship In Elementary Education (1-6 credit hours)
Supervised opportunities for advanced professional development in contexts concerned with elementary grades education.

Typically offered in Fall and Spring

Engineering (E)

E 101 Introduction to Engineering & Problem Solving (1 credit hours)
An introduction to the College of Engineering as a discipline and profession. Emphasis on engineering design, interdisciplinary teamwork, and problem solving from a general engineering perspective. Overview of academic policies affecting undergraduate engineering students. Exposure to College of Engineering and university-wide programs and services.

Prerequisite: Engineering Majors, Freshman standing
Typically offered in Fall only

E 102 Engineering in the 21st Century (2 credit hours)
This interdisciplinary course will provide an overview of the fourteen engineering grand challenges of the 21st century and their relationships to all of the separate engineering disciplines in the College of Engineering. The lectures will incorporate examples, guests, and specific readings on the challenges in sustainability, health, vulnerability, and the joy of living to advance civilization into the next century. Students will gain an appreciation for the methods in which engineers, in each discipline, acquire knowledge and design tools or interdisciplinary solutions essential to meet society's future needs. Course is available to 25% non-engineering students.

Restriction: Freshmen only with completion of a college introductory course, i.e. E101
GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

E 115 Introduction to Computing Environments (1 credit hours)
Introduction to the NC State computing system, and to student-owned computing resources. Includes topics such as maintaining your own computer, learning about campus-based computing resources and applications (how to access and use them), ethics and professionalism in the use of computing resources, introduction to web development and other campus resources.

Typically offered in Fall, Spring, and Summer

E 122 Engineering Academic Success (1 credit hours)
This 8-week course is designed to teach students a variety of proven strategies for creating greater academic, professional, and personal success. Enrollment is required of students in the College of Engineering who were unsuccessful in completing E101 and/or have an earned GPA less than 2.0 after the first semester of the freshman year. Topics include: time management, goal setting, stress management, study skills, learning styles, and campus resources using a platform of lectures and guest speakers.

Typically offered in Spring only

E 144 Academic and Professional Preparation for Engineering I (1 credit hours)
Assist new freshmen engineering students in the transition from high school to the collegiate environment. Cover critical-thinking; problem solving techniques; academic skills and time management.

Typically offered in Fall only

E 145 Academic and Professional Preparation for Engineering II (1 credit hours)
Engineering as a field of study and profession. Career and professional development, goal setting, decision making and effective communication strategies.

Typically offered in Spring only

E 201 Engineering Transfer to Success (1 credit hours)
This 8-week course will provide an overview of the NC State University policies and procedures, organizations, and resources available for enhancing the academic success of new transfer students in the College of Engineering. Lectures and discussion from departmental representatives will focus on requirements and availability for financial aid, cooperative education, career services, and campus student organizations. Emphasis will be placed on acclimating student through teamwork and academic achievement within the first year of transfer.

Prerequisite: E101 or Introduction to College Course
Typically offered in Fall only

E 298 Special Topics Engineering (1-3 credit hours)
Typically offered in Spring only

E 304 Introduction to Nano Science and Technology (3 credit hours)
Fundamental concepts of Nano-Science and Technology including scaling, nano-scale physics, materials, mechanics, electronics, heat transfer, photonics, fluidics and biology. Applications of nano-technology.

Prerequisite: MA 242 and PY 208 with grade of C- or higher
Typically offered in Fall and Spring

E 480 Namibia Wildlife Aerial Observatory (6 credit hours)
Namibia Wildlife Aerial Observatory (WAO) is restricted to junior-level and above students who participate in Namibia WAO study-abroad. The course is a purpose-driven educational experience of field work and research. The first 10 weeks take place in Namibia; of which during the first two weeks, the students receive lectures on such topics as African landscapes and wildlife, African culture, cross-cultural knowledge and skills, wildlife trade and poaching, data analysis for research, and are trained in the operation and maintenance of unmanned aerial vehicle systems (e.g. vehicles, cameras, communications) and in the following eight weeks are divided into field units that conduct aerial data collection for the purposes of meeting given wildlife missions. Upon returning to NC State, each field unit spends two-weeks (10 days) turning their findings into a research journal article for dissemination.

Junior standing or above
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

E 490 Fundamentals of Engineering(FE) Exam Preparation (1 credit hours)
Preparation for graduating seniors in engineering to take the Fundamentals of Engineering (FE) Examination. Information on how to register for the FE exam, exam strategy, and a review of selected science and engineering topics through active learning exercises directed at working sample examination problems. Credit may not be counted toward graduation

Prerequisite: Engineering Majors, Senior standing, Graduate students, or PBS status
Typically offered in Fall and Spring

E 497 Engineering Research Projects (1-3 credit hours)
Projects in research, design or development in engineering or computer science. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in College of Engineering, Engineering Scholars Program or Engineering Research Center Scholars
Typically offered in Fall, Spring, and Summer

E 531/OR 531/MA 531 Dynamic Systems and Multivariable Control I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems.

Prerequisite: MA 341, MA 405
Typically offered in Fall only

E 731/MA 731/OR 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Stability of equilibrium points for nonlinear systems. Liapunov functions. Unconstrained and constrained optimal control problems. Pontryagin's maximum principle and dynamic programming. Computation with gradient methods and Newton methods. Multidisciplinary applications.

Prerequisite: OR(E,MA) 531
Typically offered in Spring only

English (ENG)

ENG 1GEP 100 Level English Composition (3 credit hours)
100 Level English Composition. Transfer students with 3 hours of ENG 1GEP credit may receive ENG 101 equivalency by completing ENG 202 with a C- or better.

ENG 100 Reading and Writing Rhetorically (4 credit hours)
Intensive practice in reading and writing critically and rhetorically, with attention to how those change according to purpose and situation. Introduction to rhetorical concepts and elements with application to a variety of academic, professional, or civic texts. Exploration of principles of argument and organization. Guidance in developing flexible, self-aware reading and composing processes. Practice in seeking, providing, and responding to constructive feedback. Practice with making choices about grammar, mechanics, and style appropriate to specific rhetorical situations. Extensive writing practice and individualized coaching to support ongoing development as a writer. Intended as preparation for ENG 101. Departmental consent required.

Typically offered in Fall, Spring, and Summer

ENG 101 Academic Writing and Research (4 credit hours)
Intensive instruction in academic writing and research. Basic principles of rhetoric and strategies for academic inquiry and argument. Instruction and practice in critical reading, including the generative and responsible use of print and electronic sources for academic research. Exploration of literate practices across a range of academic domains, laying the foundation for further writing development in college. Continued attention to grammar and conventions of standard written English. Successful completion of ENG 101 requires a C- or better. Credit for ENG 101 is not allowed if the student has already fulfilled the first-year writing requirement.

Prerequisite: Placement via English Department guidelines
Typically offered in Fall, Spring, and Summer

ENG 202 Disciplinary Perspectives in Writing (3 credit hours)
Examination of the uses of writing and research within academic disciplines; analysis, synthesis, and reflection on what makes effective academic arguments; development of an understanding of the rhetorical demands of disciplinary writing, including attention to audience, purpose, and context; instruction in critical research practices; engagement in reflective activities on writing and research processes to help students gain facility in academic writing across disciplines and within their own discipline. Restricted to transfer students with 3 hours of ENG1** or ENG1GEP transfer credit. Together with approved transfer credit hours, this course satisfies the Introduction to Writing component of the General Education Program. Course Pre-requisite: 3 credits of ENG1** or ENG1GEP transfer credit.

P: 3 hours transferring ENG1** or ENG1GEP transfer credit
Typically offered in Fall, Spring, and Summer

ENG 206 Studies In Drama (3 credit hours)
Selected drama from the classical period to the present. Emphasis on reading for enjoyment as well as understanding theory and development of tragedy, comedy, and other modes of dramatic expression. Writers such as Sophocles, Euripides, Shakespeare, Ibsen, and Shaw, and contemporary playwrights.

GEP Humanities
Typically offered in Fall and Spring

ENG 207 Studies in Poetry (3 credit hours)
Main features of poetry such as tone, voice, form, diction, figurative language, and sound patterns. Reading of poetry from different periods with the goal of learning how to understand, appreciate, and analyze different kinds of poems.

GEP Humanities
Typically offered in Fall and Spring

ENG 208 Studies In Fiction (3 credit hours)
Representative examples of novels and short stories from different periods, emphasizing understanding and appreciation of fiction as a genre, a knowledge of the features and techniques of fiction, and a sense of the development of the genre.

GEP Humanities
Typically offered in Fall and Spring

ENG 209 Introduction to Shakespeare (3 credit hours)
Shakespeare for non-English majors. Seven to ten major plays, including representative comedies, such as The Taming of the Shrew; histories, such as Richard III; tragedies, such as Hamlet; and romances, such as The Tempest. Does not satisfy requirements for English major.

GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 210 Introduction to Language and Linguistics (3 credit hours)
Linguistics theory and method. Topics include the English sound system, morphology, syntactic structure, semantics, and historical and contemporary dialect variation. Language acquisition, language and the brain, and computer processing and human language.

Prerequisite: ENG 101
GEP Social Sciences
Typically offered in Fall and Spring

ENG 214 Introduction to Editing (3 credit hours)
Basic editorial skills with a wide range of publications. Stylistic editing (conventions of written English, consistency, effectiveness of syntax, appropriateness of diction), substantive editing (accuracy, legal issues, ethics), and production editing (layout, typography, electronic publication processing). Introduction to resources such as standard reference works and professional organizations.

Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 216 Technologies for Texts (3 credit hours)
Uses of computers for creating, designing, analyzing, and disseminating texts, both on desktops and on the Internet. Overview of technologies that facilitate reading, writing, and communication; development of skill with various applications and understanding of their capabilities, limitations, and historical analogues. Recommended for students in journalism and technical writing.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 219/FL 219 Studies in Great Works of Non-Western Literature (3 credit hours)
Readings, in English translation, or non-Western literary masterpieces from the beginnings of literacy in the Middle East, Asia, and Africa to the modern period, including excerpts from texts such as the Upanishads, the Ramayana, the Sundiata, Gilgamesh, A Thousand and One Nights, and the Quran and such authors as Confucius, Oe Kenzaburo, Omar Khayyam, Rumi, and Amos Oz.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 220/FL 220 Studies in Great Works of Western Literature (3 credit hours)
Readings, in English translation, of Western literary masterpieces, from the beginnings of literacy in the Middle East and Europe towards the present, including such authors as Homer, Sophocles, Virgil, Ovid, Augustine, Dante, Machiavelli, Shakespeare, Cervantes, Moliere, Voltaire, Goethe, Austen, Flaubert, Dickinson, Tolstoy, Kafka, and Woolf. Credit will not be given for both ENG/FL 220 and either ENG/FL 221 or ENG/FL 222.

Restricton: Credit is not allowed for both ENG 220 and ENG 221 or ENG 222.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 221/FL 221 Literature of the Western World I (3 credit hours)
Readings from English translations of Biblical, Classical, Medieval, and Early Renaissance literature, including works by such authors as Homer, Plato, Virgil, Ovid, St. Paul, St. Augustine, Marie de France, and Dante. Credit is not allowed for both ENG 221 and ENG 220.

Restriction: Credit is not allowed for both ENG 221 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 222/FL 222 Literature of the Western World II (3 credit hours)
Readings from English translations of Renaissance, Neo-Classical, Romantic, and Early Modern literature, emphasizing the cultures of continental Europe from the Renaissance to 1900, and including such authors as Petrarch, Erasmus, Rabelais, Machiavelli, Shakespeare, Moliere, Voltaire, Rousseau, Goethe, Flaubert, and Tolstoy. Credit is not allowed for both ENG 220 and ENG 222.

Restriction: Credit is not allowed for both ENG 222 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 223/FL 223 Contemporary World Literature I (3 credit hours)
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 224/FL 224 Contemporary World Literature II (3 credit hours)
Twentieth-century literature of some of the following cultures: Asian, Middle Eastern, African, Caribbean, Native-American.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 232 Literature and Medicine (3 credit hours)
Literary, cultural, and philosophical perspectives on medical science and practice, illness, epidemics, and related topics. Readings will include fiction, poetry, personal essays, film, and other media.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ENG 246/FL 246 Literature of the Holocaust (3 credit hours)
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 248/AFS 248 Survey of African-American Literature (3 credit hours)
African-American writing and its relationships to American culture and history. Covers such writers as Wheatley, Douglass, Chesnutt, Dunbar, DuBois, Hughes, Hurston, Wright, and Morrison.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 249 Native American Literature (3 credit hours)
A survey of Native American literatures from before contact with Europeans to contemporary culture. Writers may include: Apess (Pequot), Ridge (Cherokee), Silko (Laguna Pueblo), Momaday (Kiowa), Power (Sioux) Gunn Allen (Laguna-Sioux), Harjo (Creek), and Erdrich (Anishinaabe).

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

ENG 251 Major British Writers (3 credit hours)
Significant British authors chosen from among such figures as Chaucer, Shakespeare, Milton, Swift, Pope, Austen, Wordsworth, Coleridge, Tennyson, Browning, Bronte, Dickens, Joyce, Eliot, Woolf, and Yeats.Credit will not be given for both ENG 251 and either ENG 261 or 262.

Credit is not allowed for ENG 251 and ENG 261 or ENG 262.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 252 Major American Writers (3 credit hours)
Significant American authors chosen from among such figures as Franklin, Emerson, Thoreau, Hawthorne, Melville, Douglass, Stowe, Whitman, Dickinson, Twain, James, Frost, Faulkner, Hemingway, and Morrison. Credit will not be given for both ENG 252 and either ENG 265 or 266.

R: Credit will not be given for both ENG 252 and either ENG 265 or ENG 266.
GEP Humanities
Typically offered in Fall and Spring

ENG 255 Beyond Britain: Literature from Colonies of the British Empire (3 credit hours)
This course challenges students to understand the historical, political, and cultural circumstances that gave rise to literary production in 18th- and 19th-century colonial societies. The course will enable students to understand the value of reading 18th- and 19th-century literature from a global perspective, a critical component of literary studies in today's twenty-first-century world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 260 Reading Literature and Exploring Textuality (3 credit hours)
Introduces fundamental questions in literary history and critical theory. Emphasizes critical reading skills and prepares students for the kinds of courses--surveys, genre courses, author courses, problem-based courses--that are part of the Englishmajor. Papers prepared using standard word processing programs.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 261 English Literature I (3 credit hours)
A survey of English literature to 1660, including Old English, Middle English, and Renaissance writing, focusing on such central authors as Chaucer, Spenser, Marlowe, Shakespeare, Jonson, Donne, and Milton. Credit will not be given for both ENG 261 and ENG 251.

Restriction: Credit is not allowed for both ENG 261 and ENG 251.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 262 English Literature II (3 credit hours)
A survey of English literature from 1660 to the present. Poetry, fiction, drama and intellectual prose by such central writers as Dryden, Pope, Swift, Johnson, Wollstonecraft, Wordsworth, Keats, Shelley, Bronte, Carlyle, Tennyson, Browning, Yeats, Woolf, Joyce and Eliot. Credit will not be given for both ENG 262 and ENG 251.

Credit is not allowed for both ENG 262 and ENG 251.
GEP Humanities
Typically offered in Fall, Spring, and Summer

ENG 265 American Literature I (3 credit hours)
A survey of American literature from the beginnings to the Civil War, including such central authors as Edwards, Franklin, Irving, Emerson, Hawthorne, Melville, Poe, Stowe, Douglass, Thoreau, and Whitman. Credit will not be given for both ENG 265 and ENG 252.

Credit is not allowed for ENG 265 and ENG 252.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 266 American Literature II (3 credit hours)
A survey of American literature from the Civil War to the present, including such central authors as Whitman, Dickinson, Twain, James, Crane, Wharton, Frost, Eliot, Hemingway, Hurston, Faulkner, Wright, O'Connor, and Morrison. Credit will not be given for both ENG 266 and ENG 252.

Credit is not allowed for both ENG 266 and ENG 252.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 267 LGBTQI Literature in the U.S. (3 credit hours)
Chronological survey of works of literature by and about gay, lesbian, bisexual, transgender, questioning, and intersex communities in the U.S. Primary texts will be considered in historical, political, and literary contexts. Brief consideration of early works from colonial period and 19th century with primary focus on 20th and 21st century texts.

GEP Humanities
Typically offered in Spring only

ENG 275/FL 275 Literature and War (3 credit hours)
A geographical and thematic examination of war and questions it raises, as reflected in selected writings from, Homer, Sophocles, Japan's Tale of the Heike, Shakespeare, The Bhagavad-Gita, Keegan, Kipling, Graham Green, Mulden, Michael Herr, Dexter Filkins, Lucius Shepherd as well as writers on Just War and Deterrence Theory, and military science.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 281 Introduction to Creative Nonfiction (3 credit hours)
This is an introductory course that will instruct students in writing, editing and appreciating the professional nonfiction one finds in magazines, on issue-oriented websites, and in general interest publications, from the New Yorker-style long article to the personal columns one finds on online media outlets: writing about an issue or event in a personal, stylish way while obtaining the rigor of journalism in scrupulous research and clarity. In an ever-enlarging media universe, this is the most visible and commercial of all the creative writing genres.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 282 Introduction to Film (3 credit hours)
Examination of basic film techniques and methods of film analysis. Emphasis on understanding and appreciating film as a major US and international art form and industry operating in various national, cultural, and historical contexts.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 287 Explorations in Creative Writing (3 credit hours)
Introduction to the basic elements and principles of three genres of creative writing: poetry, fiction and drama. Reading and class discussion of student work. Recommended for students with no prior experience in creative writing.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 288 Fiction Writing (3 credit hours)
Experience in writing short prose fiction. Class critiquing of student work and instruction in techniques of fiction.

Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 289 Poetry Writing (3 credit hours)
Experience in writing poetry. Class critiquing of student work and instruction in techniques of poetry.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 292 Writing About Film (3 credit hours)
Comprehensive study of various approaches to writing about film. Primary focus is on the critical and evaluative practice involved in writing film criticism for non-academic audiences. Film screenings, discussion of assigned readings, and in-class writing workshops aid students in preparing a portfolio of film writing that includes film reviews of various lengths.

Prerequisite: ENG 101
GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 298 Special Projects in English (1-3 credit hours)
Faculty-guided independent study, or courses on special topics determined by departmental interest or need.

Typically offered in Fall, Spring, and Summer

ENG 300 Critical Approaches to Literature (3 credit hours)
This course introduces fundamental questions in literary history and critical theory. It emphasizes critical reading skills and prepares students for the interpretive and analytic work required of them in survey, genre, author, problem-based literature courses that are part of the English major.

P: ENG 101; R: credit will not be given for both, ENG 260 and ENG 300
Typically offered in Fall and Spring

ENG 305/WGS 305 Women and Literature (3 credit hours)
Nineteenth through twenty-first century women's literature, as shaped by the intersecting and competing claims of gender, race, sexuality, and culture. Focus on fiction, accompanied by critical readings from American studies, feminist literary criticism, and postmodern theory.

Prerequisite: Sophomore standing and above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

ENG 308/WGS 308 Contemporary Issues in Ecofeminism (3 credit hours)
Contemporary issues in ecofeminism provides a historical introduction to and global perspectives on women's sociopolitical, ethical, and economic contributions to the 20th and 21st century environmental movement. Theory and political action as they interweave issues of gender, race, and class in western and non-western contexts will be emphasized. Students will read works by and about female scientists/activists/writers and examine their own communities, analyzing the ways that individuals, community values, and dominant institutions impact women's relationships with the environment. Students will formulate questions, responses, and interpretations through critical reading practices, class discussion groups, self-reflective writing, and comparative analyses. Special attention will be paid to the role of literature--memoir, novel, short story, essay--in the dissemination of ecofeminist ideas.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 314 Technical Document Design and Editing (3 credit hours)
Layout and design principles for written documents; desktop building; legibility, readability testing; conventions of proposals, instructions, and reports; basics of technical editing: usage, vocabulary, style manuals, editing mathematical equations, graphs, tables.

Prerequisite: ENG 214
Typically offered in Fall only

ENG 315 Phonetics (3 credit hours)
This course is an introduction to phonetics: how spoken language is produced and perceived, and the physical properties of speech. An understanding of phonetics is fundamental to scientific and clinical approaches to speech and language. This course is meant to build both skills and knowledge.

Typically offered in Fall only

ENG 316 Introduction to News and Article Writing (3 credit hours)
Techniques of writing news stories and feature articles for print and the Web. Components of newsworthiness, examination of evidence, interview techniques, varied writing styles. Role of print- and Web-based journalism in America.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 317 Designing Networked Communications (3 credit hours)
A course in the layout, design, and composition of digitally-networked communication. Students will learn to analyze audiences and themselves for their uses of information in order to plan, compose, and critically evaluate digitally networked ecologies including web pages, mobile applications, and social media platforms. Students will acquire theories and skills with HTML/CSS coding, rhetorically-centered design, accessibility, and user experience and will apply those skills to the composition of a variety of digital texts. Course work will require students to become proficient with commercially-available and open source content platforms.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 320 Anatomy and Physiology of Speech (3 credit hours)
Students will learn about the anatomy and physiology of the speech mechanism including the muscular, skeletal, and nervous system structures involved in respiration, phonation, and articulation. This knowledge may be applied in clinical fields such as speech-language pathology or serve as the basis for the study of linguistic phonetics.

Typically offered in Fall only

ENG 321/COM 321 Survey of Rhetorical Theory (3 credit hours)
Principles of rhetorical theory from its classical origins through the modern period to the present time. Key concepts and theories that provide a critical understanding of the processes of persuasive symbol use.

Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 323 Writing in the Rhetorical Tradition (3 credit hours)
A writing course based on the study of rhetoric. Readings on the principles of invention, arrangement, and style; analysis of written texts; writing of persuasive texts for a variety of audiences and purposes.

Prerequisite: ENG 101
Typically offered in Fall, Spring, and Summer

ENG 324 Modern English Syntax (3 credit hours)
Study of Modern English at the sentence level. Analysis of grammatical structure. Consideration of language variation in English.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 325 Spoken and Written Traditions of American English Dialects (3 credit hours)
Basic issues in the study of language; linguistic terminology and categories; grammatical traditions and topics such as prescriptivism and descriptivism, standard and non-standard, orality and literacy; language acquisition and awareness; language aesthetics and ethics.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 326 History of the English Language (3 credit hours)
Development of the English language from its Indo-European origins to the present. Emphasis on historical and comparative linguistic methodology and on changes in sound, syntax, and meaning.

P: ENG 101
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 327/WGS 327 Language and Gender (3 credit hours)
Introduction to the use of language by men and women. Research in Linguistics and Women's Studies addressing issues such as the acquisition of gender-differentiated language, gender and conversational interaction, sexism in language, gender issues in society, and the relationship between language, gender, and other social constructs (e.g., class, culture, and ethnicity).

Prerequisite: ENG 101
Typically offered in Fall only

ENG 328 Language and Writing (3 credit hours)
Study of language structure; specific attention to differences between spoken and written language; print conventions; error analysis; and the application of linguistics to rhetoric and composition. Analysis of a variety of grammatical approaches; how to evaluate grammar textbooks and compositions. Intended for English Education majors.

Prerequisite: ENG 101
Typically offered in Fall only

ENG 329 Language and Globalization (3 credit hours)
Introduction to the sociolinguistics of globalization. Through linguistic-semiotic practices, examine how mobility, migration, and the global circulation of information and ideologies impact people, places, and practices. Study of the interplay between global flows, (trans)local contexts, and the consequences of intense contact with linguistic and cultural otherness. Topics include: English as a global language; mobility, migration, multilingualism; youth language in mobility; multilingual hip-hop; globalization and social media; multilingual signs and linguistic landscapes in urban settings.

GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 330 Screenwriting (3 credit hours)
Writing for films, story planning, character development, communicating information, building scenes, relationships between script and cinematic dimensions, working with studios and editors.

Prerequisite: 6 credit hours from courses in writing for media, creative writing, or Film Studies
Typically offered in Fall and Spring

ENG 331 Communication for Engineering and Technology (3 credit hours)
Written communication in industrial and technical organizations, emphasizing internal communication with managers and technical personnel and including external communication with regulators, vendors, and clients. Intensive practice in writing; relationship of writing to oral and visual communication. For students in engineering and other primarily technological curricula.Credit is not allowed for more than one of ENG 331, ENG 332, and ENG 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 331 and ENG 332 or ENG 333.
Typically offered in Fall, Spring, and Summer

ENG 332 Communication for Business and Management (3 credit hours)
Written communication in business and public organizations, including both internal communication (such as instructions, policies, management reports) and external communication with clients, vendors, and publics. Intensive practice in writing; relationship of writing to oral and visual communication. For students in business and management-related programs.Credit is not allowed for more than one of ENG 331, ENG 332, and ENG 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 332 and ENG 331 or ENG 333.
Typically offered in Fall, Spring, and Summer

ENG 333 Communication for Science and Research (3 credit hours)
Written communication in scientific and research contexts, emphasizing relationship between research and writing in problem formulation, interpretation of results, and support and acceptance of research. Intensive practice in writing; relationship of writing to oral and visual communication. For students who plan careers in scientific research.Credit is not allowed for more than one of ENG 331, 332, and 333.

Prerequisite: Junior standing. Credit is not allowed for both ENG 333 and ENG 331 or ENG 332.
Typically offered in Fall, Spring, and Summer

ENG 335 Language Development (3 credit hours)
This course addresses syntactic, semantic, morphologic, and pragmatic development from birth through adolescence, explores the influence of cognitive and social development on language development, and contrasts first language acquisition with second language learning.

Typically offered in Spring only

ENG 338 Speech Science (3 credit hours)
Learn about the acoustic properties of speech sounds and the dynamics of speech sound production. Become familiar with and practice the use of basic clinical instrumentation used to measure respiratory, phonatory, and articulatory movements and the acoustic events that result from these movements. Complete assignments requiring the use of basic instrumentation and computer software.

Prerequisite: ENG 320
Typically offered in Spring only

ENG 339 Literature and Technology (3 credit hours)
Introduction to how the interactions among technologies, media, and literature shape the cultural past. The course pursues studies of fictional and non-fictional texts through several disciplinary perspectives including literary criticism, communications, media theory, and history. Technologies and literary and historical eras considered will vary.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

ENG 340 Literature, Art, and Society (3 credit hours)
This course explores the intersection of literature and the arts, including the visual and/or performing arts, and their role as social commentary. It will consider the expressive power of the medium in the arts, whether that of an individual artist working across mediums or a collaboration between artists, and will examine the rich relations that have existed between literature, the arts, and important social movements of the day. Disciplinary perspectives include literary criticism, history, art history, performance studies, and museum studies.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

ENG 341 Literature and Science (3 credit hours)
This course tracks the imaginative potentials, social repercussions, and interdisciplinary mixing of literature and science since the emergence of empiricism in the sixteenth century. Well before literature and science divided into "two cultures." they supplied a fruitful crossover for ideas about how and why the world works and how we gain new knowledge. Even with the development of modern disciplines, literature plays an important role in cultural assessments of scientific discovery and education. Students will read a selection of works from literary as well as scientific writers, analyzing texts and historical contexts and producing written arguments within an interdisciplinary framework.

R: Sophomore Standing or Above
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 342 Literature of Space and Place (3 credit hours)
This course investigates how various spatial categories (for example, the city, the pastoral, wilderness, region, nation, or the globe) work in and are constructed by literary texts. Humanities fields have increasingly noted the importance of space and place in shaping our lives and as key mechanisms through which ideas of gender, sexuality, race, class, national identity, or nature are shaped. Our spatial analysis of literature will borrow from an interdisciplinary range of methods: cultural and historical geography, cartography, urban studies, and/or environmental studies. The course also addresses the historical and cultural contexts that have shaped ideas of space.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

ENG 349/AFS 349 African Literature in English (3 credit hours)
Anglophone literature in Africa. Emphasis on the relationship between the African world-view and literary production and the persistent trend by African writers to connect literature with politics. Writers such as Achebe, Ngugi, Soyinka, and Serote.

Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 350 Professional Internships (3 credit hours)
Directed work for CHASS majors including work-site mentoring and evaluation. Department supervision includes a course work directed toward designing employment application materials, developing a portfolio of professional work or relevant research paper, considering a variety of career options, and reading literature on workplace socialization. students must provide their own transportation to the internship site. Modest liability insurance fee required. Students must have at least a 2.5 overall GPA and at least a 3.0 GPA in the major, be a junior or senior CHASS major or minor, and must complete the application process outlined on the Internship Program Website or provide the internship coordinator with contact information for your supervisor at an internship you obtained independently.

Typically offered in Fall and Spring

ENG 359 Topics in Film Studies (3 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.

Typically offered in Spring only

ENG 361 Studies in British Poetry (3 credit hours)
Topics in eighteenth- and nineteenth-century British poetry. Focus on a particular theme, issue, poetic genre, or group of poets. Authors studied may include Alexander Pope, Anna Laetitia Barbauld, Charlotte Smith, Olaudah Equiano, William Blake, Dorothy Wordsworth, William Wordsworth, George Gordon, Lord Byron, Mary Shelley, Percy B. Shelley, John Keats, Felicia Hemans, Alfred Lord Tennyson, Matthew Arnold, Elizabeth B. Browning, Robert Browning, Christina Rossetti, Dante G. Rossetti, Oscar Wilde, and Gerard Manley Hopkins.

R: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 362 Studies in the British Novel (3 credit hours)
Topics in 18th and 19th century British fiction. Focus on a particular theme, issue, fictional genre, or group of fiction writers. Authors studied may include Daniel Defoe, Eliza Haywood, Henry Fielding, Samuel Richardson, Charlotte Smith, Mary Wollstonecraft, Mary Shelley, Jane Austen, the Brontes, Charles Dickens, George Eliot, Bram Stoker, Thomas Hardy, and Oscar Wilde.

R: Sophomore standing and above
GEP Humanities
Typically offered in Fall only

ENG 364/COM 364 History of Film to 1940 (3 credit hours)
Technological developments and aesthetic movements that shaped international cinema production from the beginning of the industry to 1940. Formal evolution in camera movement, editing, sound, narrative form, and the documentary. The rise to prominence of Hollywood and international cinemas in historical, economic, and cultural contexts.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

ENG 369 The American Novel of the 19th Century (3 credit hours)
Major novels illustrating the development of American fiction from Romanticism to Realism and Naturalism. Works by such writers as Brown, Cooper, Hawthorne, Stowe, Melville, Twain, Howells, James, Norris, Crane, Chopin, and Dreiser.

Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 370 American Fiction, Twentieth Century and Beyond (3 credit hours)
Study of narrative fiction written in the twentieth-century and after by American writers. This course will examine major developments in narrative form and technique, based on developments in important literary traditions such as realism, modernism or postmodernism. The course will situate the fiction in key contexts, whether literary or cultural. Representative writers: Ernest Hemingway, Gertrude Stein, William Faulkner, Toni Morrison and Cormac McCarthy.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Fall only

ENG 372 American Poetry, Twentieth Century and Beyond (3 credit hours)
Study of poetry written in the twentieth-century and after by American poets. This course will examine major developments in form and technique by poets influenced by transformative movements such as Imagism, Modernism, the Objectivists, Black Mountain poetics, New York School and subsequent developments. The course will situate poetry in key contexts, whether literary or cultural. Representative poets: T.S. Eliot, H.D., Langston Hughes, Frank O?Hara, C.D. Wright and Yusef Komunyakaa.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 374/COM 374 History of Film From 1940 (3 credit hours)
Technological developments and aesthetic movements that have shaped international cinema production from 1940 to the present. Evolution in camera movement, editing, sound, narrative form, and the documentary. Post-war Hollywood cinema and international film industries (both established and emerging) in historical, economic and cultural context.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

ENG 375/AFS 375 African American Cinema (3 credit hours)
Survey and analysis of African American film culture from 1900-present. Examination of pre-Hollywood, classical Hollywood, and Independent filmmaking. Particular focus on independent filmmakers' response to dominant industry representations and the work of filmmakers who seek to create a specifically African American cinematic style.

P: ENG 101
GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 376 Science Fiction (3 credit hours)
Representative works of science fiction. Emphasis on works written in the twentieth century, with some attention to the history and development of the genre.

Prerequisite: Sophomore standing and above
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ENG 377 Fantasy (3 credit hours)
Representative works in the genre of fantasy. Emphasis on works of 19th and 20th centuries. Authors such as Carroll, Lewis, Tolkien, Borges, LeGuin, and Gardner.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 378 Women & Film (3 credit hours)
This course will introduce students to women's participation, as well as their representation, in the history of film and other audiovisual media, including television, music videos, and performance art. The course includes screenings and addresses issues such as: the gendered nature of the gaze; film form and genre; nation and postcoloniality; spectatorship; race, class, and sexuality.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

ENG 380 Modern Drama (3 credit hours)
Major plays and playwrights from Ibsen to Churchill, including at least some of the following: Ibsen, Shaw, Chekhov, Glaspell, O'Neill, Brecht, Hughes, Hellman, Beckett, Williams, Miller, Albee, Hansberry, Walcott, Soyinka, Churchill, Kushner, and Parks.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 381 Creative Nonfiction Writing Workshop (3 credit hours)
A workshop in creative nonfiction (literary or magazine journalism) for the student with demonstrated understanding of the basic techniques of creative writing and journalism.

Prerequisite: ENG 215, 287, 288, or 289
Typically offered in Spring only

ENG 382 Film and Literature (3 credit hours)
Ways of adapting literary works to film form. Similarities and differences between these two media. Emphasis on the practical art of transforming literature into film. Attention to the impact of film upon literature.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

ENG 384 Introduction to Film Theory (3 credit hours)
Survey of critical approaches to film art. Application of theoretical paradigms--formalist, realist, psychoanalytic, feminist, poststructuralist--to individual films, genres, national cinemas and directors.

Prerequisite: ENG 282
Typically offered in Spring only

ENG 385 Biblical Backgrounds of English Literature (3 credit hours)
Influences of the Bible--principal forms, genres, and texts--on major English and American writers such as Milton, Spenser, Melville, Eliot, and Faulkner.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 388 Intermediate Fiction Writing Workshop (3 credit hours)
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing prose fiction.

P: ENG 288; R: Students must have earned a B or better in ENG 288.
Typically offered in Fall and Spring

ENG 389 Intermediate Poetry Writing Workshop (3 credit hours)
An intermediate workshop in creative writing for students with demonstrated understanding of the basic techniques of writing poetry.

Prerequisite: ENG 289;Students must have earned a B or better in ENG 289.
Typically offered in Fall and Spring

ENG 390 Classical Backgrounds of English Literature (3 credit hours)
Literature of the ancient Western world and its influence on English and American writing. Emphasis on the connections between the two bodies of literature. Covers such writers as Plato, Horace, Virgil, and St. Augustine.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 391 Special Topics in Modern Drama (3 credit hours)
Various topics in modern drama covering different cultures, issues, and theatrical practices within the last 100 years. Modern American drama, modern British drama, modern World Drama, and European theatre from World War II to the present.

Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 392/FL 392 Major World Author (3 credit hours)
Intensive study in English, of the writings of one (or two) author(s) from outside the English and American traditions. Sample subjects: Homer, Virgil and Ovid, Lady Murasaki, Marie de France and Christine de Pizan, Dante, Cervantes, Goethe, Balzacand Flaubert, Kafka, Proust, Lessing and Gordimer, Borges and Marquez, Neruda, Achebe, Soyinka, Calvino, Walcott and Naipaul. Topics will vary from semester to semester. May be repeated for credit with new topic.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 393/FL 393 Studies in Literary Genre (3 credit hours)
Concentrated treatment of one literary genre, such as the epic, the lyric, the drama, satire, romance, autobiography, the essay, the novel, or the short story. Treatment of materials from several national or ethnic cultures and several periods. All readings in English. Course may be taken three times for credit. Course may be taken 3 times in different genres.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 394/FL 394 Studies in World Literature (3 credit hours)
Study of a subject in world literature: for example, African literature, Asian literature, Hispanic literature, East European literature, Comedy, the Epic, the Lyric, Autobiography, the Faust legend, or Metamorphosis. Subjects vary according to availability of faculty. Readings in English translation.

Restriction: Sophomore Standing and Above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 395/COM 395 Studies in Rhetoric and Digital Media (3 credit hours)
Study of the influence of emerging technologies on rhetorical theory and practice. Rhetorical analysis of texts, including visual and audio texts. Invention and construction of digital media texts as a means of engaging rhetorical theory and analysis. Topics vary to adapt to emerging technologies and changing vernacular practices.

Prerequisite: ENG 101
GEP Humanities
Typically offered in Fall and Spring

ENG 399 Contemporary Literature (3 credit hours)
Literature from the twentieth-century and twenty-first century. Readings may be from various genres including fiction, non-fiction, drama, and poetry. Writers will be from the English-speaking world, but also reading may include writers outside it, that is, writers whose work has been translated into English. This course will track important developments, whether literary or cultural, in contemporary literature. Representative writers: Jean Rhys, James Baldwin, W.G. Sebald, Leslie Marmon Silko, August Wilson, Salman Rushdie and Wislawa Szymborska.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

ENG 400 Applied Criticism (3 credit hours)
Types and methods of literary criticism designed specifically for students intending to teach English in high school.

Prerequisite: TED Majors, Senior standing.
Typically offered in Fall only

ENG 405/ECI 405 Literature for Adolescents (3 credit hours)
The history, types, and characteristics of literature for adolescents. Emphasizes reading and analyzing the literature by exploring the themes, literary elements, and rationale for teaching literature for adolescents. Addresses ways in which this literature can be integrated and implemented in English/Language Arts curriculum.

Prerequisite: Junior standing.
Typically offered in Spring only

ENG 406/FL 406 Modernism (3 credit hours)
Review and discuss the International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Identify and discuss definitions of modernity, as embodied in a variety of genres. Discuss Modernist texts within a variety of cultures that produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 407/FL 407 Postmodernism (3 credit hours)
Study literary expressions of postmodernism, from its origins in the Modernist movement through its culmination in the later decades of the twentieth century and after. Examine post modernity, as embodied in a variety of genres. Situate postmodernist texts within a variety of cultures that have produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 410/WGS 410 Studies in Gender and Genre (3 credit hours)
This course examines the ways in which women writers from diverse backgrounds have revised the literary genres to include the varied experiences of women. It will focus on a different generic area, such as poetry, fiction, drama or autobiography, depending on its instructor.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

ENG 411/COM 411 Rhetorical Criticism (3 credit hours)
Rhetorical analysis of public speeches, social movements, political campaigns, popular music, advertising, and religious communication. Neo-Aristotelian criticism, movement studies, genre criticism, dramatistic analysis, content analysis, fantasy theme analysis.

Prerequisite: Junior standing

ENG 416 Advanced News and Article Writing (3 credit hours)
Advanced work in writing news stories, profiles, features, and investigative stories. Includes analysis and critical reading of print media. Assumes thorough knowledge of AP style and rudiments of news and feature writing.

Prerequisite: ENG 316
Typically offered in Fall and Spring

ENG 417 Editorial and Opinion Writing (3 credit hours)
Discussing and writing newspaper and magazine editorials, with added attention to other forms of opinion in print, such as columns and books and music reviews.

Prerequisite: ENG 214, ENG 316
Typically offered in Spring only

ENG 420 Major American Author (3 credit hours)
Intensive study of the writings of one (or two) American author(s). Developments across the career, relationships between the writing and the life, the writer's participation in a culture and an historical moment. Sample subjects: Emerson and Thoreau, Melville, Whitman, Stowe and Douglass, Dickinson, Twain, James and Wharton, Frost, O'Neill, Fitzgerald and Hemingway, Faulkner, Hurston and Wright, O'Conner, Morrison.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Fall only

ENG 421 Computer Documentation Design (3 credit hours)
Theory and design of documentation for computer hardware and software, including user guides, reference manuals, quick reference guides, tutorials, online documentation, and CD-based media delivery. Training in alternative documentation testing procedures, usability testing, and collaborative revision.

Prerequisite: ENG 214 or ENG 331 or ENG 332 or ENG 333
Typically offered in Spring only

ENG 422 Writing Theory and the Writing Process (3 credit hours)
Theory and research on the processes and contexts of written discourse; cognitive, socio-cultural, educational perspectives; reflective and research-based accounts of the writing process; analysis of discourse contexts and communities.

Prerequisite: ENG 101
Typically offered in Spring only

ENG 425 Analysis of Scientific and Technical Writing (3 credit hours)
The role of communication in the creation of scientific knowledge and technical designs and artifacts; methods of analyzing texts and of studying their creation and use; relationships between writing and other forms of communication. Field research in a scientific or technological setting.

Prerequisite: Junior standing
GEP Interdisciplinary Perspectives
Typically offered in Spring only

ENG 426 Analyzing Style (3 credit hours)
Development of a greater understanding of and facility with style in written discourse. Theories of style, stylistic features; methods of analysis, imitation.

Prerequisite: ENG 101
Typically offered in Fall and Spring

ENG 430 Advanced Screenwriting (3 credit hours)
Advanced Screenwriting students will complete ready-to-sell screenplays over the course of the semester. Workload includes taking home two 100-page scripts each week and giving a thorough critique both in writing and in class discussion. Course included pitch sessions, opening scene workshops, intensive reading and writing.

Prerequisite: ENG 330
Typically offered in Spring only

ENG 439 Studies in English Renaissance Literature (3 credit hours)
Works of non-dramatic literature written in English or circulated in England from the sixteenth and seventeenth centuries. The course puts the English Renaissance in both a European and colonial context. Genres include, but are not limited to: poetry, political and fictional prose, masques, travel writing, proto-ethnographies, and popular writing (conduct books, ballads, emblems, polemical texts). Authors may include Thomas Wyatt, Henry Howard, Isabella Whitney, Philip Sidney, Edmund Spenser, Louise Labe, Gaspara Stampa, Sor Juana Della Cruz, Castiglione, Mary Sidney, Ben Jonson, Mary Wroth, Aemilia Lanyer, John Donne, George Herbert, Margaret Cavendish, and Aphra Behn.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 448/AFS 448/ENG 548/AFS 548 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.

Requirement: Junior Standing
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

ENG 451/ENG 551 Chaucer (3 credit hours)
Introduction to the study of Chaucer through an intensive reading of The Canterbury Tales.

R: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 452 Medieval British Literature (3 credit hours)
Readings in the rich poetic, thematic, and generic diversity of Medieval British literature. Representative selections from romance, dream-vision, allegory, fabliau, lyric, chronicle, saint's life, satire, in historical and cultural contexts. Priorknowledge of Middle English unnecessary.

Prerequisite: Sophomore standing and above
Typically offered in Fall only

ENG 453 Studies in Nineteenth-Century British Literature (3 credit hours)
Topics in nineteenth-century British literature, including the novel, development of poetry, etc. Focus on special areas of interest, which will vary from year to year, with attention to cultural and historical contexts.

R: Sophomore standing or above
GEP Humanities
Typically offered in Fall only

ENG 455 Literacy in the U.S. (3 credit hours)
Academic study of the nature, functions, acquisition, institutionalization, and present state of literacy in the U.S., with special focus on issues of cultural diversity and social inequity. Three contexts for literacy - personal, academic, and home/community - provide a range of readings, investigations, and opportunities for reflection and further study.

Prerequisite: ENG 101; Junior or senior standing.
Typically offered in Fall only

ENG 460 Major British Author (3 credit hours)
In-depth study of the works of one (or two) British author(s) within their historical and literary-historical context. Sample authors might include; Spencer and Sidney, Swift and Pope, Austen, Wordsworth and Coleridge, Keats and Shelley, the Brontes, the Brownings, Dickens, George Eliot, Hardy, Joyce, Woolf.

Prerequisite: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 462 18th-Century English Literature (3 credit hours)
Major figures in English literature between 1660 and 1790. Works studied in relation to social, cultural, political, and religious developments. Emphasis on writers such as Dryden, Swift, Pope, Johnson.

Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 463 The Victorian Period (3 credit hours)
Significant British poets, writers of prose non-fiction, and novelists studied in the social, economic, scientific, intellectual, and theological contexts of the Victorian era.

Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 464 British Literature and the Founding of Empire (3 credit hours)
This course uses literature to understand rapid shifts in making and breaking empire. Reading novels, newspapers, essays, and autobiographies, we will study liberty in colonial North America, the orientalism of British India, and adventure writing of nineteenth-century Africa. In 1773, George McCartney, a British imperial officer, looked out from India and saw a "vast empire on which the sun never sets." Ten years later the thirteen American colonies that had founded that empire were gone. We will use this sentiment to determine how empire shaped the world and to consider how it contributed to Britain's literary and cultural traditions.

Requisite: Sophomore Standing or Above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 465 British Literature and the Dissolution of Empire (3 credit hours)
This course examines the role of British literature in the dissolution of empire and the reshaping of Britain as a multicultural society. As poet Louise Bennett wryly comments, the 20th century British experience is one of "colonization in reverse." From the departure of the colonies, to the impact of American expatriates and Caribbean, African and South Asian immigrants, to the Scottish nationalist critique, this period is one of radical change in British national identity. At the center of that change are the global writers who create a heterogeneous literature that represents both a "new" British literature and a post-empire reality.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

ENG 466 Transatlantic Literatures (3 credit hours)
This course will investigate notable literary exchanges in the literatures of the Atlantic Rim, long linked by trade (including slavery) as well as by commerce of many other kinds. Examples of these exchanges include Great Britain and the U.S., the U.S. and the Caribbean, and very importantly, between African cultures on the Atlantic and Atlantic cultures in the U.S. The course will explore the literary and cultural hybridity brought about by these exchanges. Representative writers: William Shakespeare and Aimee Cesaire, Joseph Conrad and Chinua Achebe; Charlotte Bronte and Jean Rhys; William Faulkner and Edouard Glissant.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

ENG 467 American Colonial Literature (3 credit hours)
Survey of American literature and thought from its beginnings to the adoption of the Constitution. Representative works such as travel and exploration reports, Indian captivity narratives, diaries, journals, autobiographies, sermons, and poetry.

R: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 468 Studies in Nineteenth-Century American Literature (3 credit hours)
Topics in nineteenth-century American literature, such as Romanticism, the nineteenth-century novel, Realism & Naturalism, etc. Focus on special areas of interest, which will vary from year to year, with attention to cultural and historical contexts.

Restriction: Sophomore Standing and Above
GEP Humanities
Typically offered in Spring only

ENG 470 American Literature, Twentieth Century and Beyond (3 credit hours)
American Literature from the twentieth century until the present day. Readings from various genres such as fiction, non-fiction, drama and poetry. Emphasis will be on key literary developments in relation to important critical/cultural contexts. Representative writers: F. Scott Fitzgerald, Gwendolyn Brooks, Zora Neale Hurston, James Baldwin, David Mamet, and Maxine Hong Kingston.

P: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

ENG 476 Southern Literature (3 credit hours)
Literary traditions of the Southeastern United States from colonization through the present, including study of such major writers as Byrd, Jefferson, Simms, Poe, Douglass, Twain, Chesnutt, Glasgow, Hurston, Tate, Wolfe, Faulkner, Warren, Wright, Welty, Williams, O'Conner, Percy, and Lee Smith.

Prerequisite: Sophomore standing and above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

ENG 480 Modern Drama (3 credit hours)

ENG 481 History of the Book (3 credit hours)
This course provides an overview of book history from the invention of the hand-written codex through the printing press and current digital manifestations, including electronic texts and Google Books. Students will examine rare materials in hands-on settings and during field trips to special collections libraries; try out historical techniques of writing, printing, and manufacture; and investigate the many social roles involved in creating and using books, including those of author, editor, printer, publisher, reader, and seller.

Restriction: Junior standing or above
Typically offered in Spring only

ENG 482 Reading in the Digital Age (3 credit hours)
This capstone questions how textual, reading, and interpretive practices are changing in a digital age. Using a diverse sample of literature, the course explores the consequences of digital remediation for texts and literary studies. Students will learn concepts in mediation, analyze works of literature on different reading platforms, and experiment with computational methods for literary curation, quantitative analysis, and data visualization. Students of all technical levels are welcomed; no special skills are required beyond basic familiarity with a computer.

Junior standing or above
Typically offered in Spring only

ENG 483 Literature and Media (3 credit hours)
This course will explore how shifts in media technologies have influenced the creation, transmission, and reception of literature. Topics might include: investigations of how the spread of printing presses led to the first newspapers in eighteenth-century London, with comparison to how newspapers look today; study of the importance of serial publication in magazines for nineteenth-century authors like Charles Dickens; and examinations of spy novels, detective fiction, and the rise of the paperback in the twentieth century before turning to the explosion of graphic novels in the twenty-first century.

Restriction: Junior standing or above
Typically offered in Spring only

ENG 485 Shakespeare: Revisions and Resources (3 credit hours)
A study in the plays of Shakespeare and ways to teach them, using multi-media presentations and textual exegesis, concentrating on each performance as an unique interpretation. The play choices are chosen by examining the plays that students in the English Ed program will likely find themselves teaching in area high schools.

P: 6 credit hours of English above the 100-level
GEP Humanities
Typically offered in Fall only

ENG 486 Shakespeare, The Earlier Plays (3 credit hours)
Study a selection of Shakespeare's major works before 1603 with an emphasis on his cultural context and development as a playwright.

Restriction: Sophomore Standing and Above
GEP Humanities
Typically offered in Fall only

ENG 487 Shakespeare, The Later Plays (3 credit hours)
Study a selection of Shakespeare's major works after 1603 with an emphasis on his cultural context and development as a playwright.

R: Sophomore standing and above
GEP Humanities
Typically offered in Spring only

ENG 488 Advanced Fiction Writing Workshop (3 credit hours)
An advanced workshop in creative writing for students with demonstrated understanding and accomplishment in the techniques of writing prose fiction.This course is restricted to juniors and seniors. Departmental approval required.

Prerequisite: ENG 388
Typically offered in Fall and Spring

ENG 489 Advanced Poetry Writing Workshop (3 credit hours)
An advanced workshop in creative writing for the students with demonstrated understanding and accomplishment in the techniques of writing poetry.This course is restricted to juniors and seniors. Departmental approval required.

Prerequisite: ENG 389
Typically offered in Fall and Spring

ENG 490 Studies in Medieval Literature (3 credit hours)
Topics (in rotation) in medieval English and continental literature, such as Arthurian legend and literature; women in medieval society and literature; the self in the late Middle Ages. Focus on special areas of interest, with attention to culturaland historical backgrounds and contemporary scholarship. Some texts in Middle English, some in translation; no prior knowledge of Middle English needed.

Prerequisite: Sophomore standing and above
Typically offered in Spring only

ENG 491 Honors in English (3 credit hours)
Intensive course or independent study project designed as one portion of the Honors Program in English. Subject varies.

Requisite: English Majors Only
Typically offered in Fall and Spring

ENG 492 Special Topics in Film Styles and Genres (3 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester.

Typically offered in Fall and Spring

ENG 494 Special Topics in Linguistics (3 credit hours)
Methodology and analysis within various branches of linguistics, e.g. syntax, semantics, computational linguistics, phonology, dialectology, historical linguistics, discourse analysis. Examination of the topic's basic methods, controversial issues, analysis of linguistic data. Projects may include novel analyses of English constructions, parsing programs, or field work reports. (May be repeated for credit with a new topic.)

Prerequisite: ENG 101 & Junior standing
Typically offered in Spring only

ENG 495 Studies in Literature (3 credit hours)
Intensive exploration of selected topics or issues in the area of literature/ English studies with a wide variation in content that sometimes includes materials from several national or ethnic cultures and periods. Course may be used to meet the capstone requirement in the English literature concentration.

Junior standing or above
Typically offered in Spring only

ENG 496 Seminar in Literary Criticism (3 credit hours)
Introduction to theoretical and applied criticism of literature, primarily for English majors and minors. May include traditional theory from Plato and Aristotle to New Criticism, as well as contemporary psychoanalytical, social, historical, and linguistic approaches to literature.

Prerequisite: 9 hours of literature at the 300 level or above
Typically offered in Fall and Spring

ENG 498 Special Topics in English (1-6 credit hours)
Directed individual study or experimental course offerings in language or literature. Individual study arranged through consultation with faculty member and Director of Undergraduate Studies.

Prerequisite: Six hours in ENG above the 100 level
Typically offered in Fall, Spring, and Summer

ENG 499 Special Topics in Creative Writing (3 credit hours)
Techniques and practice in writing a particular form within the traditional genres of poetry, prose, or drama, such as "Creative Non-Fiction," "Science Fiction," "The Novella," or "The Satirical Poem." Topics vary from semester to semester.

Prerequisite: ENG 288 or ENG 289 ; Students must have earned a grade of B or better in 288 or 289 or they must have demonstrated competence in creative writing as determined by instructor.
Typically offered in Fall and Spring

ENG 505 Writing Program Administration: Theory, Practice, and Research (3 credit hours)
Seminar designed to focus on current theories, research, and practices of writing program administration, including curricular design and assessment, faculty development, assessment of student achievement, budget oversight, the politics of administration in higher education, and historical studies of writing program administration. Designed for all interested MA, MFA and PhD students, but particularly valuable for those considering administrative work in first-year writing programs, writing centers, or WAC/WID/CAC programs at a range of institutions (community colleges, small liberal arts colleges, and large research universities). Course involves the study of an existing program through contact with its director(s).

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 506/COM 506 Verbal Data Analysis (3 credit hours)
Research strategies for understanding how spoken and written language shapes activities (e.g., design, instruction, counseling, gaming interactions, e-commerce, etc.). Tracking patterned uses of language as verbal data (e.g., grammatically topically, thematically), formulating research questions, and designing studies to answer those questions through quantitative descriptive means. Sampling, collecting and managing data, developing coding schemes, achieving reliability, using descriptive statistical measures, and reporting the results.

Typically offered in Fall only

ENG 507 Writing for Health and Environmental Sciences (3 credit hours)
Readings, on-site research, document gathering, and analysis of writing in health and environmental science fields. Students study, practice, and present major forms of writing in their profession. Professional portfolio due at the end of the semester. Intended for students interested in exploring or pursuing writing careers in medicine, pharmaceuticals, nutrition, agriculture, ecology, or other health and environmental science-related industries, or professionals who wish to improve knowledge and skills.

Prerequisite: Graduate standing, Doctoral student, Master's student
Typically offered in Fall only

ENG 508 Usability Studies for Technical Communication (3 credit hours)
Advanced study of usability inspection, inquiry, and testing theories and practices related to instrumental and instructive texts (i.e., computer-related, legal, medical, pharmaceutical, financial, etc.). Practical experience testing a variety of texts using several testing methods, including completion of a substantial, lab-based usability test. For students planning careers in technical communication, human factors, software design, and multimedia design.

Prerequisite: ENG 517
Typically offered in Fall only

ENG 509 Old English Literature (3 credit hours)
Study of Old English language with selections from important poems including Beowulf. Examination of the poetry in the light of various modern critical approaches.

Typically offered in Spring only

ENG 510 Middle English Literature (3 credit hours)
Study of major works of medieval English literature (exclusive of Chaucer's Canterbury Tales) in historical context, as reflections of and influences on social and cultural change. Includes works such as Sir Gawain and the Green Knight, Pearl, Langland's Piers Plowman and Malory's Morte d'Arthur.

Typically offered in Spring only

ENG 511 Theory and Research In Composition (3 credit hours)
Research and scholarship in composition and the teaching of writing. Major theoretical perspectives (such as expressive, social, cognitive, feminist), current issues (such as audience, invention, revision, evaluation) and various research methods.

Typically offered in Fall and Spring

ENG 512 Theory and Research In Professional Writing (3 credit hours)
Introduction to research and scholarship in professional writing and writing in the workplace. Major theoretical perspectives for studying writing; current issues (such as usability, readability, collaboration, gender, authorship); and various research methods.

Typically offered in Fall only

ENG 513 Empirical Research In Composition (3 credit hours)
Reading and evaluation of empirical research in written composition; guided practice in qualitative and quantitative methods. Basic principles of research; problem definition, research design and statistical analysis, description and assessment of written products and processes.

Typically offered in Spring only

ENG 514/COM 514 History Of Rhetoric (3 credit hours)
Historical development of rhetorical theory with attention to contemporaneous rhetorical practice and philosophical trends. Major focus on the classical period with briefer coverage of medieval, Renaissance, 18th-century, and 19th-century developments. Implications for contemporary theory and practice, including pedagogical practice.

Typically offered in Fall only

ENG 515 Rhetoric Of Science and Technology (3 credit hours)
The relationships among rhetoric, scientific knowledge and technological development and of changes in how these relationships understood historically. Practice in critical analysis of scientific and technical discourse. Consideration of scientific and technical language and of public controversy concerning science and technology.

Typically offered in Fall only

ENG 516/COM 516 Rhetorical Criticism: Theory and Practice (3 credit hours)
Development, achievements, limitation of major critical methods in the 20th century, including neo-Aristotelian, generic, metaphoric, dramatistic, feminist, social-movement, fantasy-theme and postmodern approaches. Criticism of political discourse,institutional discourse, discourses of law, medicine, religion, education, science, the media. Relations between rhetorical and literary criticism and other forms of cultural analysis.

Prerequisite: Graduate Standing or the equivalent of COM/ENG 321 or COM/ENG 411
Typically offered in Spring only

ENG 517 Advanced Technical Writing, Editing and Document Design (3 credit hours)
Advanced study of technical communication practice, including content management, document design, and technical editing and usability. For students planning careers as technical communicators.

P: ENG 314 or graduate standing
Typically offered in Fall only

ENG 518 Publication Management for Technical Communicators (3 credit hours)
Advanced study of publication and team management issues such as staffing, scheduling, cost-reduction and subcontracting. For students planning careers as technical communicators.

Prerequisite: ENG 517
Typically offered in Spring only

ENG 519 Online Information Design and Evaluation (3 credit hours)
Concepts and practices related to multimedia information design, information architectures, human-computer interaction, and genre for complex websites.

Prerequisite: ENG 517
Typically offered in Spring only

ENG 520 Science Writing for the Media (3 credit hours)
Coverage of three areas: how to write science articles for a variety of mass media, how to think critically about how mass media cover science, and how to think critically about science itself. Preparation for careers not only in mass media, but also in scientific and technological organizations.

Typically offered in Fall only

ENG 522 Writing in Nonacademic Settings (3 credit hours)
Directed work experience for English Department graduate students including work-site mentoring and evaluation and concurrent academic assignments. Academic component includes reading and discussing articles relevant to the day-to-day practice of writing in nonacademic settings and completion of a project that connects academic and nonacademic components. Graduate Standing in an English Department graduate program required. Modest liability insurance fee required. Students must provide their own transportation to the practicum site.

Typically offered in Spring only

ENG 523 Language Variation Research Seminar (3 credit hours)
Field-initiated research. Group and individual research topics focused on current sociolinguistic issues related to language variation and changes. Ethnographic and quantitative methods of analysis.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 524 Introduction to Linguistics (3 credit hours)
Introduction to theoretical linguistics, especially for students in language, writing and literature curricula. Phonology, syntax, semantics, history of linguistics; relation of linguistics to philosophy, sociology and psychology; application of theory to analysis of texts.

Prerequisite: Graduate standing or 12 hrs. in ENG
Typically offered in Fall only

ENG 525 Variety In Language (3 credit hours)
Language variation description, theory, method and application; focus on regional, social, ethnic and gender varieties; sociolinguistic analysis, basic discourse analysis.

Prerequisite: Graduate standing or 12 hrs. in ENG
Typically offered in Fall only

ENG 527/ENG 727 Discourse Analysis (3 credit hours)
Overview of major issues, theories, and research methods in contemporary discourse analysis. It explores how language as a form of social practice regulates social actions, relations and identities; how ways of speaking construct and are constructed by social order, cultural practice, and individual agency. Texts/discourses are analyzed to examine how speakers create meaning through formal linguistic choices; what the micro-organization of talk reveals about social order; how critical understanding of discourse helps to interpret complex processes of social life.

Prerequisite: Graduate standing
Typically offered in Fall only

ENG 528 Sociophonetics (3 credit hours)
A survey of sociophonetics: the study of language variation using modern phonetic techniques. Acoustic analysis of consonants, vowels, prosody, voice quality. Speech perception experiments and how they can be applied to a variety of issues. Applications to theoretical issues in sound change, sociolinguistics, phonetics and phonology, and cognition of language. Graduate standing required.

Typically offered in Fall only

ENG 529 16th-Century Non-Dramatic English Literature (3 credit hours)
Prose and poetry of the English Renaissance, excluding drama. Special attention to major authors, including Spenser and Sidney, and to intellectual, cultural and literary backgrounds and developments. Introduction to pertinent methods and issues of scholarly inquiry and critical interpretation.

Typically offered in Fall only

ENG 530 17th-Century English Literature (3 credit hours)
A close examination of the literature of England from 1600 to 1660 with emphasis on major literary figures and movements, development of important literary forms and genres and relationship between literary texts of this period and their philosophical, political and theological contexts. Some bibliographical and textural assignments. Content and focus varies according to instructor's emphasis, but writers covered usually include Donne, Herbert, Crashaw, Marvell and Browne.

Typically offered in Spring only

ENG 531 American Colonial Literature (3 credit hours)
Survey of American literature and thought from the beginning to adoption of the constitution. Representative works such as travel and exploration reports, Indian captivity narratives, diaries, journals, auto biographies, sermons and poetry.

Typically offered in Spring only

ENG 532 Narrative Analysis (3 credit hours)
Introduction to theories concerning the structure, use, and interpretation of narratively organized discourse; application of methods of narrative analysis to both spoken and written narratives.

Prerequisite: Graduate standing
Typically offered in Fall only

ENG 533 Bilingualism and Language Contact (3 credit hours)
Linguistic, cultural and socio-political aspects of bi- and mulitlingualism in a global context. Issues and implications of bilingualism from both theoretical and practical perspectives. Topics inlcude: language maintenance and shift; child and adult bilingualism; relationship between language, culture and identity in bi- and multilingual situations; psycholinguistic aspects and lingustic outcomes of bilingual contact, such as code-switching, convergence and language attrition; language ideology, the politics of language choice and language policy; globalization and intercultural communication. Must hold graduate standing or get consent of instructor for advanced undergraduate students.

Typically offered in Spring only

ENG 534 Quantitative Analysis in Sociolinguistics (3 credit hours)
The quantitative methods specific to sociolinguistic variation are examined in detail, focusing both on gaining experience using quantitative analysis software and on understanding fundamental concepts underlying the quantitative analysis of language variation. This course takes students beyond the basic familiarity with quantitative analysis gained in ENG 523, both in depth of investigation and in attention to the link between method and theory.

Typically offered in Fall only

ENG 536 Research Methods in Phonology (3 credit hours)
This course explores laboratory and computational tools for investigating linguistic sound systems (e.g., speech perception experiments, speech production tools such as ultrasound imaging, and computational tools such as automated transcription and acoustic measurement). Requires enrollment in the Sociolinguistics MA or PhD program or permission of instructor.

Requisite: Enrollment in the Sociolinguistics concentrations of the MA English or PhD Sociology programs or permission of instructor.
Typically offered in Fall only

ENG 539/FL 539 Seminar In World Literature (3 credit hours)
Rotating topics in world literature, including treatment of the subject's theoretical or methodological framework. Possible subjects: colonialism and literature; orality and literature; the Renaissance; the Enlightenment; translation; comparison ofNorth and South American literatures; African literary traditions; post-modernism and gender. Readings in English (original languages encouraged but not required).

Typically offered in Spring only

ENG 540 History Of Literary Criticism (3 credit hours)
Survey of the history of literary criticism from Antiquity to early Modern period. Introduction to major theoretical definitions of literature and modes of practical criticism. Close study of Aristotle's Poetics, Sidney's Apology for Poetry, Pope's Essay on Criticism, Coleridge's Biographia Literaria, Eliot's essays and other landmark works in development of literary criticism.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

ENG 541 Literary and Cultural Theory (3 credit hours)
A survey of literary theory in the 20th century from New Criticism to postmodernism. Examines the virtues and pitfalls of these approaches to the study of culture and literature. A course on issues, concepts, theorists and the sociohistorical and political context in which the theorists are writing. Taught in English. No formal pre-requisites. However, students who have not had advanced literature will be disadvantaged.

Typically offered in Fall only

ENG 543 Introduction to Digital Humanities (3 credit hours)
This course invites students of all technical abilities to explore the ongoing digital transformation of resources, tools, and methods in the humanities. As an introduction, this course is a gateway into a variety of representative subfields in digital humanities. It is designed to generate curiosity about how this emerging arena of scholarly activity might intersect with students' own disciplines, research interests, and pedagogies. It aims to provide a working knowledge of: 1) backgrounds of new media and humanities computing, 2) debates and outlooks for the digital humanities today, as well as 3) hands-on experience collaborating on, creating, and critiquing digital humanities projects.

Prerequisite: Graduate standing
Typically offered in Fall only

ENG 548/AFS 548/ENG 448/AFS 448 African-American Literature (3 credit hours)
Survey of African-American literature and its relationships to American culture, with an emphasis on fiction and poetry since 1945. Writers such as Bontemps, Morrison, Hurston, Baldwin, Hayden, Brooks, Naylor, Harper, and Dove.

Requirement: Junior Standing
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

ENG 549 Modern African Literature (3 credit hours)
The works of the most important writers shaping modern African literature in English (and English translation). Selections from East, West, North and South Africa, spanning colonial through post-colonial Africa--from literature of protest and culture conflict to that of disillusionment, reappraisal and feminism.

Typically offered in Spring only

ENG 550 British Romantic Period (3 credit hours)
A study of British literature during the Romantic era (1780s-1830s), including poetry, periodicals, novels, drama, and criticism as well as their political and cultural contexts.

Typically offered in Fall only

ENG 551/ENG 451 Chaucer (3 credit hours)
Introduction to the study of Chaucer through an intensive reading of The Canterbury Tales.

R: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

ENG 554/COM 554 Contemporary Rhetorical Theory (3 credit hours)
Contemporary rhetorical theory covering the 20th and 21st centuries. Conceptual connections with and disruptions of the classical tradition and its, successors; relationship between rhetorical theory and philosophical trends, institutional histories, socioeconomic circumstances, and pedagogical needs. Attention to current issues such as the revival of invention, rhetorical agency, and ethics.

Typically offered in Spring only

ENG 555 American Romantic Period (3 credit hours)
The literary culture of the United States from 1820s through 1860s, setting works of transcendentalists and other romantic writers within sociohistorical contexts. Consideration of writing by women, slave narratives and popular fiction as well as such major figures as Emerson, Hawthorne, Thoreau and Melville.

Typically offered in Fall only

ENG 558 Studies In Shakespeare (3 credit hours)
An intensive study of a particular phase of the Shakespeare canon. Emphasis will normally be on one dramatic genre (tragedy, comedy, history), but occasionally the focus may be more limited.

Typically offered in Fall and Summer

ENG 560 British Victorian Period (3 credit hours)
Explore how writers represented the tumultuous Victorian era (1837-1901), spanning responses to industrialization, political reform, religion, colonialism, class, gender, and race at home and abroad. The course covers an array of literary forms and seeks to include perspectives from within the British Isles as well as from across the British empire.

Typically offered in Fall and Spring

ENG 561 Milton (3 credit hours)
An intensive reading of Milton with attention to background materials in history and culture of seventeenth-century England.

Typically offered in Spring only

ENG 562 18TH-Century English Literature (3 credit hours)
British writers of the period 1600-1790 studied in historical and cultural contexts. Usually includes works by Dryden, Swift, Pope, Defoe, Mandeville, Boswell and Johnson, but addition of other significant writers possible.

Typically offered in Fall only

ENG 563 18TH-Century English Novel (3 credit hours)
Selected British novels of the Restoration and eighteenth century from a variety of contemporary critical perspectives. Such writers as Fielding, Richardson, Sterne, Burney, Smollett and Austen.

Typically offered in Spring only

ENG 564 Victorian Novel (3 credit hours)
Study of selected British novels published between 1837 and 1901 in contexts of the development of the genre, historical period and current literary theory. Such writers as Dickens, Thackeray, Bronte, Trollope, Eliot, Meredith and Hardy.

Typically offered in Spring only

ENG 565 American Realism and Naturalism (3 credit hours)
Study of literary culture of United States from 1860s to early 1900s with emphasis on fiction by such realists and naturalists as Twain, Howells, Chesnutt, James, Crane, Wharton, Dreiser and Norris. Inclusion of prose of writers such as Adams and DuBois possible.

Typically offered in Spring only

ENG 570 20TH-Century British Prose (3 credit hours)
Examination of British fiction of this century and relationship of significant intellectual, historical and political issues. Inclusion of such writers as Joyce, Conrad, Woolf, Lawrence, Beckett and Murdoch possible but also post-colonial novelists as well.

Typically offered in Fall only

ENG 571 20TH-Century British Poetry (3 credit hours)
Development of English poetry from its late Victorian phase through Modernism to present post-war scene. Inclusion of such writers as Hardy, Yeats, Eliot, Smith, Auden, Larkin, Heaney, Wolcott and Hill possible.

Typically offered in Spring only

ENG 572 Modern British Drama (3 credit hours)
Survey of modern British drama from its beginnings at turn of the century to present.

Typically offered in Fall only

ENG 573 Modern American Drama (3 credit hours)
A survey of modern American drama centering on major figures.

Typically offered in Fall only

ENG 575 Southern Writers (3 credit hours)
Introduction to literary culture of "the South," tracing the roots of the twentieth-century "Southern Renaissance" in such ante-bellum genres as plantation fiction, Southwestern humor, fugitive-slave narration and pastoral elegy. Examination of persistence of "Southern" writing within increasingly standardized culture of the United States.

Typically offered in Spring only

ENG 576 20TH-Century American Poetry (3 credit hours)
Development of modern American poetry from rebellion against the romantic and genteel verse of the 1890's; special attention to Robinson, Frost, Pound, Williams, Stevens and Ransom.

Typically offered in Spring only

ENG 577 20th-Century American Prose (3 credit hours)
An examination of representative American writers of novel and short fiction.

Typically offered in Spring only

ENG 578 English Drama To 1642 (3 credit hours)
Elizabethan and Jacobean drama from 1580 to 1642, excluding Shakespeare. Coverage of such writers as Marlowe, Jonson, Webster, Beaumont and Fletcher, Heywood, Tourneur and Ford.

Prerequisite: ENG 261 and upper division or Graduate standing
Typically offered in Fall only

ENG 579 Restoration and 18th-Century Drama (3 credit hours)
Representative British plays of the period 1660-1780 studied in cultural, social and ethical contexts. Usually includes works by Etherege, Wycherley, Behn, Dry-den, Otway, Vanburgh, Farquhar, Congreve, Lillo, Gay, Goldsmith and Sheridan.

Typically offered in Spring only

ENG 580 Literary Postmodernism (3 credit hours)
Post-1945 literary theory in relationship with representative avant-garde writers. Theoretical and argumentative essays in such areas as chaos theory, deconstruction, feminism and the limits of fiction. Fiction readings by Calvino, Pynchon, Barthelme, Cortazar and others.

Prerequisite: Graduate standing
Typically offered in Spring only

ENG 581/COM 581 Visual Rhetoric: Theory and Criticism (3 credit hours)
Application of visual theory to rhetoric and of rhetorical theory to visual forms of communication. Discussion and analysis may include advertising, photography, news and informational media, political communication, instructional material, scientific visualization, visual arts, public commemorative artifacts, internet and other digital media.

R: Graduate Students Only
Typically offered in Spring only

ENG 582 Studies in Literature (3 credit hours)
Variation in content. Selected problems and issues in literature.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 583 Studies In Rhetoric and Writing (3 credit hours)
Variation in content. Selected problems and issues in rhetoric and writing.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 584 Studies In Linguistics (3 credit hours)
Variation in content. Selected problems and issues in linguistics.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 585 Studies In Film (3 credit hours)
Variation in content. Selected problems and issues in film.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 586 Studies In Theory (3 credit hours)
Variation in content. Selected problems and issues in theory.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENG 587 Interdisciplinary Studies in English (3 credit hours)
Content varies. Selected topics and issues that cross disciplinary boundaries in English Studies. May be repeated for credit with different topics. Graduate standing is required.

Typically offered in Fall and Spring

ENG 588 Fiction Writing Workshop (3 credit hours)
Advanced work in techniques of writing fiction for students with substantial experience in writing. Workshop sessions with students commenting on each other's work.

Prerequisite: ENG 488 or ENG 489
Typically offered in Fall and Spring

ENG 589 Poetry Writing Workshop (3 credit hours)
Advanced work in techniques of writing poetry for students with substantial experience in writing. Workshop sessions with students commenting on each other's work.

Prerequisite: ENG 488 or ENG 489
Typically offered in Fall and Spring

ENG 590 Studies In Creative Writing (3 credit hours)
Techniques special to a particular kind of writing within the traditional genres of prose, poetry or drama, such as "Speculative Fiction" or "The Long Poem or Poetic Sequence." Various subjects.

Prerequisite: ENG 588 or 589
Typically offered in Spring only

ENG 591 Studies in National Cinemas (3 credit hours)
Aesthetic develpments and historical importance of national cinema traditions in specific cultural contexts. Focus on the relation between cinema and linguistic, literary and artistic develpments within a national setting or in regional or international contexts. Topics, which change each year, may include Italian Neorealism, French New Wave, and British Social Realism.

Typically offered in Spring only

ENG 592 Special Topics in Film Styles and Genres (1-6 credit hours)
Critical approaches to focused film topics involving film genres, directorial styles, or trends within a national cinema. Topics will vary from semester to semester. Students cannot obtain credit for both ENG 492 and ENG 592.

Typically offered in Fall and Spring

ENG 610 Special Topics English (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ENG 624 Teaching College Composition (3 credit hours)
Preparation for teaching college composition. Introduction to pedagogical principles and practices. Practice in setting course goals, designing writing assignments to meet those goals, developing instructional activities to support assignments, andevaluating student writing. The course is scheduled as a 5-day workshop before classes begin, followed by weekly meetings and mentoring during the fall semester.

Prerequisite: ENG 511 and mentored assistantship in ENG 101
Typically offered in Fall only

ENG 626 Advanced Writing for Empirical Research (3 credit hours)
A seminar and workshop for graduate students in empirical research fields working on grant proposals, theses and dissertations, papers for professional journals, conference proposals, and other significant research texts. Intensive practice and feedback on writing, grounded in an introduction to theory and research on writing processes, products, and contexts. Requirements include three major writing projects designed by the student, review and discussion of drafts written by other workshop members, analysis and presentation of discipline-specific communication patterns and practices.

Prerequisite: Graduate standing
Typically offered in Fall only

ENG 636 Directed Readings (1-6 credit hours)
Intensive study of a specific topic from various specializations of the English faculty. Negotiation between the student and the director for variable credit and approved by Director of Graduate Studies.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ENG 669 Literature, Methods, and the Profession (3 credit hours)
This course initiates students into ways of thinking and practicing in English literary studies. We will explore critical traditions, research methods, and emerging approaches, including literary criticism and theory, globalization, transnationalism, and postcolonialism in literature, together with introductions to cultural studies, rhetoric, composition, film studies, and media studies as they influenced literary criticism and theories. The course also prepares students to begin formulating their own academic and professional pathways with attention to practical considerations of how to become a professional in graduate school. You will become familiar with faculty from the department, develop research plans, and discover resources to start trajectories that include careers in writing, media, and teaching.

Typically offered in Fall only

ENG 675 Projects in Technical Communication (3 credit hours)
Capstone course for M.S. in Technical Communication. Students engage in major semester-long individual project under direction of instructor.

Prerequisite: ENG 518
Typically offered in Spring only

ENG 676 Master's Project in English (3 credit hours)
Individual capstone project in English Studies. Topic and mode of study determined in consultation with faculty project advisor. For students in the final semester of the English MA program.

Typically offered in Fall and Spring

ENG 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

ENG 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall only

ENG 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENG 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

ENG 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENG 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ENG 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Summer only

ENG 722 Linguistics and Literacy (3 credit hours)
Focus on two-way relationship between linguistic theory and literacy. Metalinguistic awareness and acquisition of literacy, orthography and phonology, oral vs. written language, oral vs. literate cultures, and metalinguistic assumptions in linguistic theory.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 727/ENG 527 Discourse Analysis (3 credit hours)
Overview of major issues, theories, and research methods in contemporary discourse analysis. It explores how language as a form of social practice regulates social actions, relations and identities; how ways of speaking construct and are constructed by social order, cultural practice, and individual agency. Texts/discourses are analyzed to examine how speakers create meaning through formal linguistic choices; what the micro-organization of talk reveals about social order; how critical understanding of discourse helps to interpret complex processes of social life.

Prerequisite: Graduate standing
Typically offered in Spring only

ENG 729 Language Variation and Social Theory (3 credit hours)
Although the field of sociolinguistic variation has developed its own body of theory, its central questions continue to call for engagement with theory in related socio-cultural disciplines. This course examines sociolinguists' explicit and implicit incorporation of social theory into the analysis of language variation; it also explores the many ways in which social theory could yet enrich, and be enriched by, empirical sociolinguistic analysis.

Prerequisite: ENG 523
Typically offered in Spring only

ENG 730 Ethnolinguistic Variation (3 credit hours)
This course examines the nature of ethnolinguistic variation in the English-speaking diaspora, with particular attention to the ethnic varieties in the United States, including African American English, Hispanic English, and Native American English.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 731 Applied Sociolinguistics (3 credit hours)
This course will introduce the main research concentrations and methods in Applied Sociolinguistics, including first language acquisition and teaching, second language learning, bilingualism, and clinical assessment and treatment of communication disorders. Students will be introduced to the basic foundations of language variation from linguistic and sociocultural/historical perspectives and learn how sociolinguistic variation affects clinical and educational processes and organizations.

Prerequisite: ENG 525
Typically offered in Spring only

ENG 798 Special Topics in English Studies (3-6 credit hours)
Intensive exploration of specialized or emerging topics in an area of language, literature, rhetoric, film, or other aspect of English studies. Emphasis on student research and writing. May be used to test and develop new courses. May be repeated for credit.

Typically offered in Fall and Spring

ENG 810 Directed Readings in English Studies (1-6 credit hours)
Intensive study of a specific topic from various specializations of the English faculty. Negotiation between the student and the director for the variable credit and approved by the director of Graduate Studies. May be repeated for credit.

Typically offered in Fall and Spring

ENG 896 Summer Dissert Res (1 credit hours)

Entomology (ENT)

ENT 110 General Entomology (3 credit hours)
Considers how insects live, their internal and external structures and their functions, classification and identification and control when desirable. Recognition of economically important beneficial and destructive insects and mites occurring in North Carolina and neighboring states, stressing information on their life histories , damage and control.

Requisite: Agricultural Institute Only
Typically offered in Fall only

ENT 121 Pesticides and Their Utilization (3 credit hours)
Basic characterization, classification, chemical and physical properties of pesticides. Use of pesticides including environmental effects; Federal and State laws and regulations relating to their manufacture, distribution and use; safety procedures including handling and storage; and application equipment including types, calibration, use and maintenance. TOTH

Requisite: Agricultural Institute Only
Typically offered in Fall only

ENT 132 Urban Pest Management (3 credit hours)
Insects and related arthropods found in residential and industrial buildings, nature of damage, and their control. Identification and life history of the different pest species, methods to detect their presence, and integrated pest management strategies. Hands-on learning of species in laboratory with emphasis on current control techniques. Field trips required. Agricultural Institute Students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

ENT 163 Ornamental & Turf Insects (3 credit hours)
Practical course in the biology, recognition, and management of common insect and related arthropod pests that attack ornamentals and turf. WALDVOGEL

Requisite: Agricultural Institute Only
Typically offered in Spring only

ENT 190 Current Topics in Pest Management (1 credit hours)
Discussions of current topics of pest management. Topics selected by the students and instructors to include different phases of pest management. Discussions led by leaders in the various facets of the industry.

Requisite: Agricultural Institute Only
Typically offered in Spring only

ENT 201 Insects and People (3 credit hours)
An introduction to the fascinating world of insects and how they interact with people. Included is a brief survey of insect history, diversity, structure and function, and behavior. This is followed by examples of beneficial and harmful insects in a variety of human activities including some sampling of the profound impacts insects have had on history, society and culture.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

ENT 207 Insects and Human Disease (3 credit hours)
This course is an introduction to the many interactions between insects, other arthropods and humans that result in disease, ranging from simple anxiety, phobias, discomfort and pain, to transmission of pathogenic organisms causing sickness and even death. Included will be an understanding of the special physical and chemical adaptations of insects that enable them to cause us harm. The major groups of insects, mites, ticks and related arthropods associated with human suffering and disease as well as an introduction to the diseases transmitted by them will be presented. Finally, the course will present information on how major outbreaks of disease transmitted by the insects have influenced human populations, demographics, warfare, religion, and societal structure throughout recorded history.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Spring only

ENT 212 Basic Entomology (1 credit hours)
This course offers a brief and basic introduction to the world of insects and the discipline of entomology. It is intended as a primer for several other more specialized entomology classes such as forensic entomology and forest entomology.

Typically offered in Fall and Spring

ENT 305 Introduction to Forensic Entomology (3 credit hours)
This course provides a broad overview of forensic entomology- a specialized field of entomology employed in medicocriminal investigations. Forensic entomology relies on knowledge of insect ecology, biology, taxonomy, physiology and development to elucidate the circumstances surrounding death. The role of arthropods associated with decomposed human remains is one of several valued disciplines in forensic sciences. Understanding the general principles of forensic entomology and their application will be the focus of this course.

GEP Natural Sciences
Typically offered in Fall only

ENT 401 Honey Bee Biology and Management (3 credit hours)
A hands-on course in honey bee management including bee pollination of selected crops based on an understanding of bee biology, bee behavior, bee pathology, and bee botany. Students must be able to provide their transportation to field sites or arrange to work with a beekeeping mentor. Students may choose, but are not required, to purchase their own beekeeping equipment and hive.

Prerequisite: (ENT 201, ENT 203, ENT 425, BIO 105 or PB 200)
Typically offered in Spring only

ENT 402/FOR 402 Forest Entomology (3 credit hours)
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.

Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Spring only

ENT 425 General Entomology (3 credit hours)
This course explores the science of entomology by focusing on the basic principles of systematics, morphology, physiology, development, behavior, ecology, and management of insects. Field trips provide opportunities to collect insects and study their adaptations to a wide variety of natural environments.

Prerequisite: BIO 181 or BIO 140 or BIO 350
GEP Natural Sciences
Typically offered in Fall only

ENT 470/PP 470/CS 470 Advanced Turfgrass Pest Management (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pestmanagement programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

ENT 492 External Learning Experience (1-6 credit hours)
A learning experience within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ENT 493 Special Problems in Entomology (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

ENT 495 Special Topics in Entomology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ENT 502 Insect Diversity (4 credit hours)
Diversity of insect biology and structure with emphasis upon identification of adults; includes speciation, evolutionary relationships, approaches to classification, nomenclature, zoogeography and techniques of collection.

Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 503 Insect Morphology and Physiology (3 credit hours)
The objectives are to acquaint students with the internal morphology, histology, and ultra-structure and system functions of insects. The laboratory will assist in recognizing the internal anatomy and associated external structure of insects and provide practical experience in the study of insect function.

Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227) and ENT 425 or Graduate Standing
Typically offered in Spring only

ENT 504 Professional Development for Agriculture and the Life Sciences (2 credit hours)
A successful professional career in agriculture and the life sciences is not limited to understanding just the science of these disciplines. Also required is an understanding of career paths, professional ethics, written and verbal communication, safety, how to work with animals and human subjects, personal interactions, vita preparation, networking, and future directions of the discipline. These skills are essential to taking the knowledge obtained in our science and applying them to a career in the discipline. Graduate Standing required.

Typically offered in Fall only

ENT 506/GES 506 Principles of Genetic Pest Management (3 credit hours)
Introduction to the biological aspects of genetic pest management (GPM). Genetic techniques for GPM, including historical uses (such as the sterile insect technique) and approaches that are currently in development. Practical issues relating to the deployment of GPM, including ecological and economic considerations.

Typically offered in Fall only

ENT 510 Writing Proposals in Agriculture, Biology, and Ecology (2 credit hours)
Participants will be guided through the process of writing, with the intention to submit, a fellowship or grant proposal to an appropriate program of their selection and effective peer review of grant or fellowship proposals. The course includes a combination of lectures, in class activities, and direct practice. Students will also interact with a wide variety of experts in grant writing and evaluation who serve as weekly guest reviewers.

Typically offered in Fall only

ENT 520 Insect Behavior (3 credit hours)
This course stresses comprehensive coverage of the principles of animal behavior using insects as models and examples. Physiology, genetics, mechanisms, behavioral ecology, and evolution of insect behavior will be covered.

Typically offered in Spring only

ENT 526 Organic Agriculture: Principles and Practices (3 credit hours)
This is a multidisciplinary class, and lectures cover many aspects of organic production given by a number of experts from both on and off campus. Classes also include discussions of issues and controversies surrounding organic production, as well as field trips to selected farms. This course is restricted to upper level undergraduate, graduate, or post-baccalaureate continuing education students.

Typically offered in Spring only

ENT 550 Fundamentals of Arthropod Management (3 credit hours)
The principles underlying modern methods for protecting food, clothing, shelter and health from insect attack.

Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 582/ZO 582 Medical and Veterinary Entomology (3 credit hours)
The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control.

Prerequisite: ENT 425 and ZO 315
Typically offered in Spring only

ENT 591 Special Topics In Entomology (1-6 credit hours)
A variable credit lecture and laboratory series offering topics such as advanced beekeeping, morphology, physiology, systematics, behavior, biological control, nursery and ornamental pests, host plant resistance, information retrieval, biological monitoring and sampling, population modeling, extension entomology, computer methods and urban, forest and stored product pests.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENT 601 Seminar (1 credit hours)
Discussion of entomological topics selected and assigned by seminar chair.

Prerequisite: Graduate standing in ENT or closely allied fields
Typically offered in Fall and Spring

ENT 604 Insect Natural History and Field Ecology (1 credit hours)
Diversity of ecological roles and lifestyles of insects and related arthropods using techniques in field ecology. Two week-long field trips to Coastal Plain and Mountains with orientation walks, evening lectures, and field projects.Taught during the two weeks prior to the Fall semester.

Prerequisite: Graduate standing in Entomology
Typically offered in Fall only

ENT 620 Special Problems (1-6 credit hours)
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research. Credits Arranged.

Typically offered in Spring only

ENT 641 Agricultural Entomology Practicum (3 credit hours)
Practical experience in research, extension and commercial aspects of insect pest management on a broad range of agricultural crops under actual field conditions. Class meets 9 hours each Friday for 10 weeks from early June to mid-August. Students should register for Fall term.

Prerequisite: Economic entomology (ENT 762 recommended)
Typically offered in Fall only

ENT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

ENT 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

ENT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENT 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENT 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ENT 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ENT 726 Biological Control of Insects and Weeds (3 credit hours)
Overview of the field of biological control and its role in Integrated Pest Management programs. Emphasis on the diversity and sometimes unusual interactions of insect parasitoids and predators with their hosts/prey, controversies in biological control, critical analysis of selected projects, and basic conceptual and "hands-on" tools for approaching biological control research and implementing projects.

Prerequisite: ENT 425 or Graduate Standing
Typically offered in Fall only

ENT 727/PP 727 Ecology of Soil Ecosystems (3 credit hours)
This course will focus on the interactions between soil organisms and their environment, and the ecological consequences of these diverse complex interactions. In particular, it will explore the scientific evidence that illustrates links between soil organisms, ecosystem functioning and the quality of air and water systems, and examine why and how the related research was conducted. This course will bring together theory and research trends from distinct subject areas: soil microbiology, entomology and ecosystem ecology.

Prerequisite: One course in: (SSC 332, SSC 511, SSC 521, or SSC 532), or ecology (BO 360 or CS 430), or microbiology (MB 351), or consent of instructor.
Typically offered in Spring only

ENT 731 Insect Ecology (3 credit hours)
The interrelationships among insects and components of their effective environments which result in dynamic spatial and temporal patterns of particular species. Also, the diverse roles of insects in structure and function of communities and ecosystems.

Prerequisite: ENT 425 or Graduate standing
Typically offered in Spring only

ENT 762 Insect Pest Management In Agricultural Crops (3 credit hours)
Critical review of the biology and ecology of representative beneficial and injurious insects and arachnids of agricultural crops and the advantages and limitations of advanced concepts of their management in selected agroecosystems.

Prerequisite: Graduate Standing
Typically offered in Spring only

ENT 791 Special Topics In Entomology (1-6 credit hours)
A variable credit lecture and laboratory series offering topics such as advanced beekeeping, morphology, physiology, systematics, behavior, biological control, nursery and ornamental pests, host plant resistance, information retrieval, biological monitoring and sampling, population modelling, extension entomology, computer methods and urban, forest and stored product pests.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ENT 801 Seminar (1 credit hours)
Discussion of entomological topics selected and assigned by seminar chair.

Prerequisite: Graduate standing in ENT or closely allied fields
Typically offered in Fall and Spring

ENT 804 Insect Natural History and Field Ecology (1 credit hours)
Diversity of ecological roles and lifestyles of insects and related arthropods using techniques in field ecology. Two week-long field trips to Coastal Plain and Mountains with orientation walks, evening lectures, and field projects.Taught during the two weeks prior to the Fall semester.

Prerequisite: Graduate standing in Entomology
Typically offered in Fall only

ENT 820 Special Problems (1-6 credit hours)
Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research.

Typically offered in Spring only

ENT 841 Agricultural Entomology Practicum (3 credit hours)
Practical experience in research, extension and commercial aspects of insect pest management on a broad range of agricultural crops under actual field conditions. Class meets 9 hours each Friday for 10 weeks from early June to mid-August. Students should register for fall semester.

Prerequisite: Economic entomology (ENT 762 recommended)
Typically offered in Fall only

ENT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ENT 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

ENT 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ENT 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ENT 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ENT 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Entrepreneurship in Music and the Arts (EMA)

EMA 110 Introduction to Arts Entrepreneurship (3 credit hours)
This course introduces students to the basic components of an entrepreneurial lifestyle in the arts for those interested in starting an arts business. Students explore fundamental issues arts entrepreneurs encounter and how they can be addressed before the startup process reaches the launch cycle. Students are required to provide their own transportation to and cover the admission costs of off-campus events.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 293 Independent Study in Arts Entrepreneurship (1-3 credit hours)
Independent study offering under the direction of a faculty member. Requirements for the independent study will be determined by the student and faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

EMA 295 Special Topics in Arts Entrepreneurship (1-3 credit hours)
Timely topical courses or experimental course offerings in Arts Entrepreneurship.

Typically offered in Fall and Spring

EMA 365 Foundations in Arts Entrepreneurship (3 credit hours)
This course will introduce and outline the role, purpose, and perception of "art" in various marketplaces and contexts for the emerging arts entrepreneur. Topics include: issues in marketing aesthetic products, consumer identification through art, models of consumer behavior, art and technology, macro-economic issues that affect the arts industries, arts policy and access.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 370 Practical Arts Entrepreneurship (3 credit hours)
This course will introduce and outline the cultural and economic environment of the arts in the United States. Topics include: the start-up process of for- and non-profit entities, economic and social impact of art and artists in communities, public and private arts support, non-profit culture and basic grantsmanship, arts policy, creative economy efforts, the role of geography, demand and infrastructure considerations in entrepreneurial decision-making, competition analysis and marketing.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EMA 375 Understanding the Arts Economies (3 credit hours)
This course explores arts and arts-related economies of critical importance to the emerging arts entrepreneur. Topics include: creative, experimental and hybrid economies, Arts infrastructure in urban and rural areas, arts clusters, patronage, broader economic conditions effecting arts economies, the relationship of "art" to segmented technology economies.

Prerequisite: EMA 370
Typically offered in Fall only

EMA 430 Capstone Experience in Arts Entrepreneurship (3 credit hours)
Students analyze arts and arts-related businesses through the use of case studies in addition to executing an entrepreneurial project concerning the arts in a Raleigh community. This class introduces students to the decision-making skills necessary to sustain arts ventures and focuses on constructing innovative solutions to common problems arts and arts-related entrepreneurs encounter. Information gained from the prerequisite courses will be put to authentic use in either a non- or for-profit setting. Transportation and some costs may be required for project work.

Prerequisite: EMA 375
Typically offered in Spring only

EMA 493 Advanced Independent Study in Arts Entrepreneurship (1-3 credit hours)
Advanced Independent Study offering under the direction of a faculty member. Requirements for the independent study will be determined by the student and faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

Entrepreneurship Initiative (EI)

EI 100 Entrepreneurial Thinking in the Albright Entrepreneurs Village (1 credit hours)
Course involves active discussion about current events, case studies and assigned reading to evaluate strategies needed to think like an entrepreneur. Our students will think critically and apply basic skills needed when joining or forming teams to launch ideas or ventures. This course will host only residents of the Albright Entrepreneurs Village to discuss these ideas and build upon the living and learning community's learning outcomes.

R: Albright Entrepreneurs Village
Typically offered in Fall only

EI 201 Exploring Interdisciplinary Entrepreneurial Thinking (3 credit hours)
Course covers the perspectives of entrepreneurial thinking from an interdisciplinary perspective including: expectations and understanding of successful entrepreneurs as well as entrepreneurial opportunities in a variety of disciplines and entities including sciences, technology, humanities and social sciences. Primary focus will be on developing the student's entrepreneurial mindset.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

EI 202/SLC 202 CREATE: Carolina Regional Entrepreneurship Albright Team Experience I (2 credit hours)
The purpose of this course is to equip students with the skills and competencies to guide high school students through the Carolina Regional Albright Team Experience (CREATE). Students will think critically and apply skills related to leadership, entrepreneurial concepts, teaching and facilitation while working with high school students. This course prepares students to design their own interactive curriculum which they will facilitate in the spring semester. Instructor approval required for registration.

Corequisite: Must also enroll in SLC/EI 203, instructor approval required
GEP Interdisciplinary Perspectives
Typically offered in Fall only

EI 203/SLC 203 CREATE: Carolina Regional Entrepreneurship Albright Team Experience II (1 credit hours)
This course builds upon the foundation set in SLE/EI 202 CREATE I. Students will continue to think critically and apply skills related to leadership, entrepreneurial concepts, teaching and facilitation while preparing students for the spring competition. This semester is focused on facilitation and mentorship and helping the high school students finish their group projects.

Prerequisite: SLC/EI 202 or approval from instructor
Typically offered in Spring only

EI 331 Interdisciplinary Entrepreneurial Thinking I: Skills and Planning Basics (3 credit hours)
Course covers the development and application of critical skills in entrepreneurship as well as the fundamentals of entrepreneurial planning including interdisciplinary opportunity identification and feasibility analysis. Some individual off campus travel might be required. Students are responsible for their own transportation to off campus activities. Students will not receive credit for both EI 331 and MIE 412.

Prerequisite: EI 201
GEP Interdisciplinary Perspectives
Typically offered in Spring only

EI 495 Independent Study in Entrepreneurship (3 credit hours)
The Independent Study in Entrepreneurship (EI 495) is designed to give students the opportunity to create their own experiential learning activity within the scope of an academic environment. EI 495 projects should be designed to meet the criteria for a 3 credit hour course. Before moving forward with the request to enroll in EI 495, the student should first work with their Independent Study sponsor to define the Independent Study contract. This course is restricted to students who have obtained faculty permission to enroll.

Typically offered in Fall, Spring, and Summer

Environmental Assessment (EA)

EA 501 Environmental Stressors (3 credit hours)
Introduces students to how organisms are affected by and respond to changes or stressors - both natural and human-induced - in the environment. With a focus on the concepts most significant to the field of environmental assessment, the course emphasizes the fundamental processes and effects of pollutants and naturally-occurring substances in the environment, including emerging issues and historically significant cases.

Prerequisite: Graduate standing
Typically offered in Fall only

EA 502 Environmental Risk Assessment (3 credit hours)
This course provides students with an appreciation and understanding of the principles of environmental risk assessment including: Hazard Identification, Toxicity Assessment, Exposure Assessment, and Risk Characterization. Emphasis is placed on contemporary problems in human health and the environment, and it will be based on the most current methodologies described in the "Risk Assessment Guidance for Superfund." Enrollment in the course requires graduate standing or consent of the instructor. Two semester sequence of college biology & college chemistry.

Prerequisite: Two semester sequence of college biology & college chemistry.
Typically offered in Spring only

EA 503 Environmental Exposure Assessment (3 credit hours)
Provides students with an appreciation and understanding of the principles of environmental exposure assessment including the sources, transport and fate of chemicals in the environment. Emphasis is on contemporary problems in human health and the environment, covering topics such as: transformation and degradation processes, classes of contaminants a well as predicting environmental fate and exposure. Enrollment in the course requires graduate standing or consent of the instructor. Two semester sequence of college biology & college chemistry.

Prerequisite: Two semester sequence of college biology & college chemistry.
Typically offered in Fall only

EA 504 Environmental Monitoring and Analysis (3 credit hours)
Monitoring and analysis of chemical and biological impacts to the environment. Theory of chemical, physical, biological, and ecological monitoring. Planning and conducting environmental sampling and monitoring programs. Management, analysis, and quality assurance and control. Enrollment in the course requires graduate standing or consent of the instructor.

Prerequisite: One Year College Biology and One Year College Chemistry
Typically offered in Summer only

EA 505 Environmental Assessment Law & Policy (3 credit hours)
This course provides students with an appreciation and understanding of the principles of environmental law and policy. Emphasis is on the US legal system and litigation process relevant to environmental law, covering topics such as: the National Environmental Policy Act (NEPA), the Pollution Prevention Act (PPA), the Clean Water Act, and the Clean Air Act. Throughout the course, a case study is integrated into the conceptual lecture material with the intent of providing practical examples to conceptual material.

Graduate standing and EA 501 and EA 502 or EA 503
Typically offered in Spring only

EA 506 Water Quality Assessment (3 credit hours)
Introduces students to topics fundamental to the understanding of aquatic systems and the processes that influence water quality. Covered topics include the hydrologic cycle, water chemistry, aquatic ecology, aquatic toxicology, water quality laws and standards, water quality assessment and techniques, and water pollution control and treatment. Emphasis is on contemporary water quality issues such as nutrient enrichment, introduced species, contaminants, and climate change.

Prerequisite: Graduate standing
Typically offered in Spring only

EA 507 National Environmental Policy Act Procedures (3 credit hours)
Procedures and requirements for implementing the National Environmental Policy Act (NEPA) when projects involve a federal nexus, including permitting and consultation among agencies in the planning process. Illustrating the five NEPA mandates and examining implications for data generation and monitoring that result from responsibilities vested in the Council of Environmental Quality.

Typically offered in Fall only

EA 508 Data Analysis in Environmental Assessment (3 credit hours)
This course provides students with an appreciation and broad understanding of environmental data, their analysis, and use in exposure and risk assessments. Topic areas include sources and types of environmental data and exposure/risk models; environmental data processing, cleansing, and visualization techniques; and a refresher to basic environmental data analyses useful for comparisons and evaluation. Numerous case-study activities are used to demonstrate learned concepts using publicly available data from environmental research publications and databases. Emphasis is placed on practical applications commonly used in environmental and health analyses and will be focused on data tools available in spreadsheet programs (e.g., Microsoft Excel(TM), Google sheets).

P: Graduate Standing
Typically offered in Fall only

EA 509 Air Quality for Environmental Assessment and Fire Science (3 credit hours)
Students will learn about assessment of air quality and will examine specific air pollutant problems induced by wildfire. The course will begin with a review of the criteria air pollutants, including sources, chemistry, transport, and dispersion. The majority of the course will focus on environmental assessment of the criteria pollutants. Units will include requirements of the National Ambient Air Quality Standards (NAAQS), monitoring methods and their biases, air pollution monitoring networks, compliance, permitting, and air pollution effects on health, ecology, climate, and equity. Throughout the semester, we will examine these topics through cases pertaining to wildfires.

P: Graduate Standing
Typically offered in Fall only

EA 520 Renewable Energy Policy and Economics (3 credit hours)
This course will cover global frameworks, as well as local, utility, state and federal policy and incentives that foster renewable energy implementation. It will also cover fundamental concepts of finance and economics to build a renewable energy project model that show how these policies affect the economics of a renewable energy project.

Prerequisite: Graduate standing
Typically offered in Fall only

EA 521 Fundamentals of Renewable Energy Site Assessment (3 credit hours)
This course will cover solar site assessment, wind assessment, and bioenergy with required exercises using current industry tools to assess the viability of the resource. Overview of the historical and current role of wind, solar, and bioenergy power technologies globally and the direction of each sector's evolution for the future, particularly in the USA. The course emphasizes the technology behind power generation for wind, solar, and bioenergy sectors. Students will evaluate policy and permitting issues and, consequently, determine if a site is appropriate for implementation of either or all of these technologies.

Prerequisite: Graduate Standing
Typically offered in Spring only

EA 522 Photovoltaic Design and Assessment (3 credit hours)
This course covers fundamental principles of the application, design, installation, and operation & maintenance of Photovoltaic (PV) systems in order to properly assess the best system options for a specific project or application. The course will begin with some background on electric energy and its use and delivery. In addition, the course will cover economic implications of the site and PV system considerations. Building on this foundation we will then take an in-depth look at solar photovoltaic function and design to aide students in assessing the environmental, and financial, sustainability of the project. This interdisciplinary approach allows the student to gain a comprehensive understanding of photovoltaics beyond the technical, and caters to individuals across a range of experience and expertise.

Prerequisite: Graduate Standing
Typically offered in Fall only

EA 523 Assessment of Renewable Energy Storage Systems (3 credit hours)
Energy Storage and operations and maintenance have become two areas in clean energy, particularly in the PV industry that have been rapidly evolving. This course will offer the basics of battery technology, as well as current market trends and incentives, to provide students timeless tools to assess the best possible option for a specific renewable energy + storage project. Meanwhile, the operations and maintenance portion will go through industry best practices that not only deal with technical management of a solar asset, but also understanding financial implications of the project. This interdisciplinary approach allows students of diverse STEM and non-STEM professional experience and expertise to gain a comprehensive understanding of this aspect of the solar industry.

Prerequisite: Graduate Standing and EA 522
Typically offered in Spring only

EA 590 Special Topics in Environmental Assessment (1-6 credit hours)

EA 665 Professional Project (1-6 credit hours)
Environmental assessment project conducted under the mentorship of a member of the graduate faculty.

Prerequisite: EA 502, EA 503, and EA 504
Typically offered in Fall, Spring, and Summer

Environmental Science (ES)

ES 100 Introduction to Environmental Sciences (3 credit hours)
Interrelationships between human populations and the natural environment. Human population trends, agriculture, air and water pollution, biological diversity, forest and land use, energyand mineral resources, and toxic substances. Consideration of related economic factors, laws, politics, political behavior, and ethical questions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ES 111 Applications of Environmental Sciences (1 credit hours)
Applications of Environmental Sciences provides Environmental Sciences majors deeper exploration of topics presented in Introduction to Environmental Sciences (ES 100) through hands-on activities, small-group discussion, and interaction with environmental professionals. Students build skills in data analysis, collaboration, and communication; learn more about Environmental Sciences focal areas and how to select theirs; and begin developing peer networks and mentor relationships with others in the field. Course is restricted to Environmental Sciences majors.

Corequisite: ES 100 or student has received transfer or AP credit for ES100; Environmental Sciences majors only
Typically offered in Spring only

ES 113 Earth from Space (3 credit hours)
This course takes an orbital perspective on Earth and its natural resources. Particular attention is paid to how humans are changing Earth, challenges to sustainably managing natural resources, and how satellite Earth observation has enabled these discoveries. Students will gain a fundamental understanding of how satellite sensor systems work, how they enable us to understand the dynamic Earth, and the role that remote sensing plays in natural resource challenges.

GEP Global Knowledge, GEP Natural Sciences
Typically offered in Fall only

ES 150 Water and the Environment (3 credit hours)
This interdisciplinary course focuses on the essential role of water in supporting all life on earth, and the expected impacts of rapidly changing water resources. Aspects of water issues will include physical sciences and engineering, life sciences, and social sciences. Case studies outline the importance of water in the global context and in specific settings, including North Carolina. The course will help prepare students for living in a rapidly changing world.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

ES 200 Climate Change and Sustainability (3 credit hours)
This course explores the relationships between humans and the environment with interdisciplinary content. Focus is on past impacts of climate change on human activities and future prospects. Course content is based on lectures with students also responsible for developing and presenting seminars.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

ES 295 Special Topics in Environmental Science (1-4 credit hours)
Provides instruction on rapidly emerging curriculum. Also provides courses on an experimental basis before incorporation into the curriculum. See specific course offering for course details.

Typically offered in Fall and Spring

ES 300 Energy and Environment (3 credit hours)
This course explores relationships between humans, energy, and the environment with interdisciplinary context. Themes include environmental impacts of energy production, distribution and use with discussion of new technologies. Half of the course content is from subject lectures and half from self-selected student projects. Student projects emphasize analytical approaches to solving environmental problems, and enhance skills in writing, seminars, and team work.

Prerequisite: CH 101 or PY 212 or PY 208
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

ES 400 Analysis of Environmental Issues (3 credit hours)
A capstone course for students in environmental sciences or related majors. The course teaches use of analytical approaches for solving environmental problems, and for communicating results. The course emphasizes development of student projects that lead to environmental decision-making, such as devising a resource management plan, developing a predictive model, prioritizing risk, identifying tipping points, designing new software or technologies, or predicting outcomes of environmental polices. Individual student projects fit within a team framework to simulate a work environment. Students enhance writing and seminar skills. Student may incur extra expenses with projects for this course.

Prerequisite: ES 100, ES 200, ES 300 and Senior standing
Typically offered in Fall and Spring

ES 449/PRT 449 Human Dimensions of Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program examines human dimensions of natural and environmental conservation in Australia. The course will involve an orientation and lectures from faculty at James Cook University. Students wills explore the natural environments in Australia including Great Barrier Reed, Tropical Rainforest and Outback and be introduced to Australian culture and history through interactions with communities. Educational travel, active participation, lectures, seminars, and reflective exercises facilitate learning to improve understanding of relationships between human societies and the natural environment. Students must pay program fees, airfare, some meals, and incidentals.

Corequisite: PRT 450
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

ES 450/PRT 450 Sustaining Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program will examine issues related to natural history and environmental conservation in Australia. This course will involve an orientation and lectures from Australian university faculty. Students will explore natural environments in Australia including the Great Barrier Reef, Tropical Rainforest and Outback; learn about sustainable development and protection of the natural environment through educational travel, field trips, active participation, lecture presentations and seminars, written assignments, research projects and reflective exercises. Students must apply through NCSU Study Abroad Office. Students must pay program fees, airfare, some meals and incidentals.

Corequisite: PRT 449
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

ES 495 Special Topics in Environmental Science (1-6 credit hours)
This course provides instruction on rapidly emerging environmental themes not currently covered in the undergraduate curriculum. Also provides courses on an experimental basis. See specific course offering for course detail.

Prerequisite: Junior standing
Typically offered in Fall and Spring

ES 496 Environmental Science Internship (1-3 credit hours)
Students can earn 1-3 credits for completing internships in the public or private sectors. Emphasis is placed on gaining work experience needed to explore and plan careers in the environmental field. Students must prepare an internship proposal. Students must provide own transportation for internship. Students are required to purchase internship liability insurance. Contact university insurance & risk management for details an acquiring the insurance and the current charge. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ES 497 Professional Development in Environmental Science (1-3 credit hours)
The course provides 1-3 credits for students who develop skills necessary to organize, promote, and participate in an event such as a workshop, conference or a seminar. Examples of acceptable events include organizing a panel of speakers on a specific topic. A speaker series, a career fair, or a workshop. The formats and topics of events are determined by the organizing student(s). Each student prepares an event proposal before the student can register for ED 497. Students must provide own transportation for professional development in environmental sciences. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ES 498 Research in Environmental Science (1-3 credit hours)
Students can earn 1 credit in ES 498 for every 50 hours of research during a semester up to a total of 3 credits for 150 of research in a semester. A student cannot complete more than 3 credits of ES 498 research in a single semester, or more than 6 credits in their program of study. Research can be traditional laboratory and/or fieldwork, or other creative activity. The student must produce a final report, seminar, or product that can be evaluated. Typically, the work for 1-3 credit of ES 498 research will be completed in one semester. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ES 499 Thesis in Environmental Science (3 credit hours)
ES 499 thesis provides academic credit for students who participate in original, inquiry-based learning and discovery in environmental sciences. Students present the thesis to a community of peers and experts for evaluation. ES 499 thesis requires a thesis proposal signed by the student, ES faculty advisor, a thesis host, and a supporting faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Environmental Technology (ET)

ET 105 Introduction to Environmental Regulations (1 credit hours)
ET 105 is a 1 hour lecture/discussion class, required of all environmental technology majors. The course reviews all the major federal and state regulations and laws addressing, water air and soil pollution; solid, toxic and hazardous waste, occupational safety/health and environmental management systems. For ET majors only.

Typically offered in Spring only

ET 120 Introduction to Renewable Energy Technologies and Assessments (3 credit hours)
Overview of the various renewable energy assessment technologies. Students will learn what assessments and measurements can be taken to determine if renewable energy technologies will be effective in a particular location. Topics include biomass and biofuels, geothermal systems, solar thermal systems, photovoltaics, wind energy, and hydroelectric.

Typically offered in Spring only

ET 201 Environmental Technology Laboratory I (1 credit hours)
Use of field and laboratory instrumentation for monitoring water quantity and quality. Management, analysis, interpretation, and oral and written reporting of complex environmental data sets. Hands-on, real-world experience in water quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Fall only

ET 202 Environmental Technology Laboratory II (1 credit hours)
Use of field and laboratory instrumentation for monitoring plants, soils, and natural systems. Management, analysis, interpretation, and oral and written reporting of complex environmental datasets. Hands-on, real-world experience in plant and soil quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Spring only

ET 203 Pollution Prevention (1 credit hours)
This course studies the prevention of the pollution of air, water, and terrestrial ecosystems. State of the art technological solutions are discussed. The social, economic, legal and ethical dimensions of pollution prevention are integrated into the scientific and technological challenges facing developed and developing economies.

Prerequisite: ES 100
Typically offered in Fall only

ET 220 Solar Photovoltaics Assessment (3 credit hours)
This course introduces specific elements in photovoltaic (PV) systems technologies including efficiency, modules, inverters, charge controllers, batteries, and system installation. Topics include National Electric Code (NEC), electrical specifications, photovoltaic system components, array design and power integration requirements that combine to form a unified structure. upon completion, students should be able to demonstrate an understanding of various photovoltaic designs and proper installation of NEC compliant solar electric power systems.

Prerequisite: ET 120
Typically offered in Fall only

ET 255 Hydro, Wind, and Bioenergy Assessment (3 credit hours)
Overview of the historical and current role of wind, hydro-electric, and bioenergy power technologies globally and the direction of each sector's evolution for the future particularly in the USA. The course emphasizes the technology behind power generation for wind, hydro, and bioenergy sectors. Students will evaluate policy and permitting issues and, consequently, determine if a site is appropriate for implementation of either or all of these technologies.

Prerequisite: ET 120
Typically offered in Spring only

ET 262 Renewable Energy Adoption: Barriers and Incentives (3 credit hours)
The understanding of the economic, social, and legal barriers and incentives to renewable energy adoption is an important facet to helping renewable energies reach their potential. This course explores mechanisms that can be used and that have been used successfully in the US and in other parts of the world to remove those barriers and to promote greater use of renewable resources, particularly in rural areas and on agricultural and forested lands.

Typically offered in Fall only

ET 293 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ET 294 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ET 295 Special Topics in Environmental Technology & Management (1-6 credit hours)
Special Topics in Environmental Technology & Management at the 200 Level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

ET 301 Environmental Technology Laboratory III (1 credit hours)
Assessment of and response to environmental hazards caused by hazardous materials releases. Regulatory requirements associated with hazardous materials releases. Utilization of chemical protective clothing and respiratory protection. Students passing the class receive Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certification. Required field trips may extend beyond lab time.

Typically offered in Fall only

ET 302 Environmental Technology Laboratory IV (1 credit hours)
Use of field and laboratory instrumentation for monitoring outdoor and indoor air quality. Management, analysis, interpretation, and oral and written reporting of complex environmental data sets. Hands-on, real-world experience in air quality monitoring and maintenance. Required field trips may extend beyond class time.

Typically offered in Spring only

ET 303 Laboratory Safety Systems and Management (1 credit hours)
Theory and practice of regulation, management, and auditing of laboratory safety. Laboratory field trips may extend beyond class time.

Typically offered in Spring only

ET 310 Environmental Monitoring and Analysis (3 credit hours)
Monitoring and analysis of chemical, biological, and radiation impacts to the environment. Theory of chemical, physical, biological, and ecological monitoring. Planning and conducting environmental sampling and monitoring programs. Management, analysis, and quality assurance and control. Risk assessment in environmental technology. Laboratory practice and safety.

Prerequisites:CH 101 or 100; BIO 181; ET students only
Typically offered in Spring only

ET 320/MEA 320 Fundamentals of Air Pollution (3 credit hours)
Students will learn fundamental concepts in air pollution and the application of those concepts for compliance with air quality regulations. Topics include air pollutants, their properties, how they are emitted, and relevant atmospheric chemistry and physics processes, National Ambient Air Quality Standards (NAAQS) and how compliance with those regulations is maintained.

Prerequisite: MA 121 or MA 131 or MA 141, CH 101/102, PY 131 or PY 201 or PY 205 or PY 211; Recommended: CH 220/222 or CH 221/222
Typically offered in Spring only

ET 330 Environmental Technology Practicum (3 credit hours)
Preparation for practicum, including resume writing, interviewing skills, cover letters, and practicum search techniques and resources. Professional practice as an environmental technologist. Written and oral communications of the practicum experience.

Typically offered in Fall, Spring, and Summer

ET 401 Environmental Technology Laboratory V (1 credit hours)
Scientific and legal definitions of brownfield and EPA Superfund sites. Physical, chemical, and biological methods for remediating contaminated sites. Impacts of hazardous waste management on public and private sector organizations. Field trips to public and private brownfield and Superfund remediation sites to examine real-world applications of principles. Required field trips may extend beyond class time.

Typically offered in Fall only

ET 455 Adaptive Management and Governance (3 credit hours)
Some environmental and natural resource problems are more difficult to resolve than others. The purpose of this course is to understand the factors that condition intractable or "wicked" environmental and natural resources conflicts. These factors include narrow conceptions of science, rigid bureaucratic structures and narrow policy targets. We also explore some of the alternatives for addressing intractable environmental and natural resource problems- including adaptive management and governance.

Junior standing or above
Typically offered in Fall only

ET 460 Practice of Environmental Technology (3 credit hours)
This capstone course will provide the opportunity to actively learn and apply the theory and practice of environmental project management and monitoring in order to perform a baseline Environmental Management System (EMS) assessment. EMS requires data collection, data analysis, report preparation, and professional recommendations to organizations on how to structure an EMS that conforms to internationally recognized guidelines and standards. Environmental Management Systems are proven tools specifically designed to help organizations manage their activities to meet their environmental policies and goals. Project management and EMS work skills are transferable across private industry, government, and not-for-profit organizations. This course will provide participants opportunities to advance work skills in project planning, stakeholder engagement, budgeting, and resource management when developing EMS initiatives. Course participants, as teams, will create and execute an EMS project work plan through practical hands-on experiences, local field-site visits, class exercises, and relevant case studies.

Prerequisite: ET 310 or SSC 442; and ET Senior Only
Typically offered in Spring only

ET 493 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ET 494 Independent Study in Environmental Technology & Management (1-6 credit hours)
Independent Study for Environmental Technology & Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

ET 495 Special Topics in Environmental Technology & Management (1-6 credit hours)
Special Topics in Environmental Technology & Management at the 400 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

Fashion and Textile Design (FTD)

FTD 104 Fashion and Textile Design First Year Studio I (6 credit hours)
This course provides Fashion and Textile Design freshman with a comprehensive introduction to foundational design concepts and methods representative of the creative thought and processes of fashion and textile design disciplines. The coursework encourages entering freshmen to think creatively through design and art, and the world around them, as they secure a skillful level of craftsmanship in the design and making of textile products. Design language, design elements and principles, and design communication and theory will be studied through readings and applications and will be experienced in person through field trips. Additional costs may be incurred for field trips.

Co-requisite: D 100
Typically offered in Fall only

FTD 105 Fashion and Textile Design First Year Studio II (6 credit hours)
This course is the continuation of the comprehensive introduction to foundational design concepts and methods representative of creative thought and activity across design and artistic disciplines, started in FTD FY Studio I. The course work encourages first year students to think critically and in depth about concept, context, material, and design process, for textile and fashion product development. There will be readings and applications in advanced design theory, including processes, methods, philosophies and related concepts. The class will involve field trips to experience these advanced design principles in person. Additional costs may be incurred.

Prerequisites: D 100 and FTD 104; Co-requisites: D 101 and FTD 200
Typically offered in Spring only

FTD 200 Design Skills Workshop (3 credit hours)
First course in developing student's use of design tools for the production of prototype products from textile materials, beginning with the selection of appropriate fabric and other raw materials and extending through critiquing the product. Concepts of ethical and sustainable design are built into the analysis and design of the product. A variety of techniques for designing sewn textile products are explored, as well as methods and safe practices for using equipment in the studio. FTD Majors Only.

Prerequisite: TT 105 and Corequisite: D 105
Typically offered in Spring only

FTD 201 Computer-Aided Textile Design and Color Studio (6 credit hours)
Application of industry textile design and visualization software to conception, design, development and presentation of creative textiles and textile products. Essential creative skills for textile design, such as motif and repeat development, will be introduced. Textile design solutions will be sampled using industrial technologies such as a digital printing, electronic knitting and computer-driven weaving. Color will be explored as a primary designer's tool including use in textile design, sensitivity and skills in communicating color, color perception and color theories, and color forecasting, creative projects will build skills in CAD for textiles and color. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: D101, D103, FTD 105, and a grade of C or better in FTD 200
Typically offered in Fall only

FTD 215 Fashion Design 1 (3 credit hours)
Studio course which introduces students to the basic rules and principles of flat pattern-making for apparel products. Advanced applications will be demonstrated through workshops utilizing concept-driven problems and follow-up critiques. Concurrent practices with computer-aided design will be presented where applicable. FTD majors only.

Prerequisite: Grade of C or better in FTD 200 and Corequisite: FTD 201
Typically offered in Fall only

FTD 216 Fashion Workroom Practices (3 credit hours)
Studio course introducing the basic concepts and practices for the creation of final garments and extending through quality analysis of the final product. Incorporates workroom techniques for production of a variety of sewn product applications using various fabrications. FTD majors only. Additional costs may be incurred for course materials/equipment.

Prerequisite: (Grade of C or better in FTD 200) or (Grade of C or better in FTM 219)
Typically offered in Spring only

FTD 218 Fashion Illustration (3 credit hours)
Concepts and practices for the fashion figure and fashion illustration, including the analysis of fashion figure structure details, proportion, and fashion figures clothed with different apparel and materials. The training of effective drawing of different fashion styles, wearing status and occasions, and the study of applying multiple illustration approaches to enhance fashion design and presentation. Additional costs may be incurred for course materials/equipment. FTD and FTM majors only.

Prerequisite: ADN 281
Typically offered in Spring only

FTD 321 Fashion Design by Draping (3 credit hours)
Exploration of three-dimensional methods of apparel design using textile substrates. Design and execution of draped garment structures will be explored in a studio setting. Additional costs may be incurred for course materials/equipment. FTD and FTM majors only.

Prerequisite: (C or better in FTD 215 and FTD 216) or (C or better in FTM 219 and FTM 315)
Typically offered in Fall only

FTD 373 Yarn Design Studio (3 credit hours)
Design of yarns and sample production, including the creation of novelty yarns, fancy yarns, and innovative effects in spun and plied fibers. Exploration of color, luster, twist, and slub variations in yarns to address both functional and aesthetic challenges. Studio experiences in creating innovative yarns appropriate for use in different fabric formation technologies. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: TT 221 or TTM 106 and a grade of C or better in FTD 201
Typically offered in Spring only

FTD 374 Surface Design and Texture (3 credit hours)
Exploration of innovative surface design and texture techniques for commercial and art applications. Embroidery, applique, stitching, fabric manipulation and aesthetic finishing processes for creative and functional design will be taught in state of the art facilities including digital printing, screen printing, cad embroidery, and industrial cad software for print design. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: TT 105 and a grade of C or better in FTD 200 and FTD 201
Typically offered in Spring only

FTD 375 Woven Textile Design Studio I (3 credit hours)
Design and sample production of woven fabrics. Exploration of basic structures, color and textural effects. Development of design abilities through creative projects executed using hand production methods, including an introduction to computer-integrated woven textile design systems and industrial processes. Study of actual fabrics and digital images, presentations will be made. Studio experience will be augmented, when possible, through outside speakers and field trips to mills. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: Grade of C or better in both TT252 and FTD 373
Typically offered in Fall only

FTD 376 Knitted Textile Design Studio I (3 credit hours)
Design and sample production of hand and machine knitted textiles. Exploration of basic structures, terms and definitions, including knitting notation and terminology. Development of creative knitted products utilizing design abilities and appropriate yarns through hand and machine production methods. Introduction to computer integrated knit design system and industrial knitting products and processes. Additional costs may be incurred for course material/equipment. FTD majors only.

Prerequisite: Grade of C or better in both TT252 and FTD 373
Typically offered in Fall only

FTD 419 Fashion Design 2 (3 credit hours)
Studio course which poses fashion problems to be solved with an emphasis on elements of design. Explores use of experimentation and development of "studies" as an aid in developing design ideas. Uses combination of flat pattern and CAD. Introduction to grading, marker making, and computer-controlled cutting. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: Grade of C or better in FTD 215, FTD 216, FTM 317, and FTD 321
Typically offered in Fall only

FTD 420 Fashion Collection Preparation (3 credit hours)
Studio course exploring sources of inspiration requiring students to research, develop and translate ideas into a line plan for a collection of garments. Stresses the extension and elaboration of ideas within a specific market. Integrates knowledge across the curriculum. Student may work with a firm, contest, or current theme to develop a fashion design statement. Additional costs may be incurred for course materials/equipment. FTD and FTM majors: Fashion Design and Fashion Development concentrations only.

Prerequisite: Grade of C or better in FTM 318 or (FTD 321 and co-requisite of FTD 419)
Typically offered in Fall only

FTD 475 Woven Textile Design Studio II (3 credit hours)
Design and sample production of specialized jacquard woven structures. Jacquard design for diverse end uses is addressed from art fabrics to unique specialty products. Exploration of advanced structures, color and textural effects. Development of design abilities through electronic production methods, including expanded use of computer-integrated design systems and exposure to industrial processes. Students will be required to complete creative design projects from concept to sample production and proposed finishing. Study of actual fabrics, digital images and presentations. Studio experiences will be augmented, when possible, through outside speakers and field trips to museum, markets, and mills. Additional costs may be incurred for course materials/equipment. FTD majors only.

Prerequisite: Grade of C or better in FTD 375
Typically offered in Fall only

FTD 476 Knitted Textile Design Studio II (3 credit hours)
Further development of knit design beyond basic design concepts and knit structures to product application. Development of creative knitted products utilizing design abilities through hand and machine production methods, including advanced methods of utilizing computer-integrated design system for both technical structures of knits and designing of garments and shaped panels. Exploration in yarn, color, and pattern design using electronic jacquard, fully fashion and seamless knitting equipment and cad systems. Consideration of other knit technologies such as warp knitting, terry, and crochet. Students will develop specifications for knitted products, and enhance understanding of industrial products and processes. Additional costs may be incurred for course material/equipment. FTD majors only.

Prerequisite: Grade of C or better in FTD 376
Typically offered in Fall only

FTD 479 Senior Textile Design Studio (6 credit hours)
Design and execution of creative projects integrating learning within curriculum, solution of textile design problems through synthesis of knowledge and skills gained through previous courses, preparation of work for portfolio, exhibition and participation in industry focused design competitions. Professional textile design practices and methods including advanced portfolio development concepts and presentation, development of textile collections suited to specified end use with emphasis on ideation, refinement, and design development, presentation and visual communication. The student will be expected to work with design, science, engineering, technology, and management disciplines. Additional costs may be incurred for course materials/equipment. Senior Standing, BS Fashion and Textile Design, Textile Design majors ONLY.

Prerequisite: FTD 374, FTD 475, FTD 476
Typically offered in Spring only

FTD 498 Senior Fashion Design Studio (6 credit hours)
Capstone for the FTD Fashion Design concentration. Design and production of a unique fashion collection applying various methods of generating patterns for garments, such as flat pattern design, draping, and CAD techniques. Relationships of body configuration and fabrication to garment design. Emphasis on ideation, creativity, communication, theme development, fit, quality, planning and execution of a fashion collection, as well as a documentary fashion portfolio. Work culminates in a Fashion show or Static exhibition format, which may be physical or virtual in format.

Prerequisite: Grade C or better in FTD419
Typically offered in Spring only

Fashion and Textile Management (FTM)

FTM 217 The Textile Industry (3 credit hours)
Study of the structure and organization of the integrated textile complex and its strategic functions. Critical stages involved in the manufacture of textile and apparel products. Fundamental aspects of cost management and finance as related to the integrated Textile Complex. One Saturday attendance during the semester is required.

Prerequisite: TT 105
Typically offered in Fall, Spring, and Summer

FTM 219 Fashion Product Analysis (3 credit hours)
Concepts and practices for the production and evaluation of fashion goods, beginning with selection of fabric and other raw materials and extending through quality analysis of the final product. Provide techniques for creating a variety of garment or sewn product applications, as well as methods for evaluation.

Prerequisite: TATM Student and FTM 217
Typically offered in Fall and Spring

FTM 220 Principles of Retailing and Supply Chain Management in Textiles (3 credit hours)
Introduction to theories and principles in fashion and textiles retailing and supply chain management including: the framework of textile retailing, textile retail strategies, textile supply chains and investigation of the strategic planning process. Emphasis placed on conducting an environmental scan, identifying and targeting the consumer, analyzing the trade area, site selection and textile product merchandise planning.

Prerequisite: FTM 217
Typically offered in Fall, Spring, and Summer

FTM 271 Computer-Aided Textile Design (3 credit hours)
Introduction to the operation of design software for woven, knitted and printed textiles. Adobe Photoshop, Pointcarre' and Monarch programs will be taught. Peripheral equipment essential to the design process will be included. Field trips to areatextile design centers. Credit not allowed for students enrolled in TT curriculum with the exception of the dual degree in the Bachelor of Art and Design and BS in Textile Technology.

Typically offered in Fall and Spring

FTM 282 Marketing Fundamentals in Textiles and Apparel (3 credit hours)
An introduction to the essential elements of brand management and marketing with specific reference to the marketing of textile and apparel goods with the integrated textile complex (from fiber to retail). The course covers both the principles and practice of marketing, in general, and provides an introduction of major concepts of brand management and marketing with a focus on branding activities used in by major textile and apparel firms within the integrated textile supply chain.

Prerequisite: FTM 217
Typically offered in Fall and Spring

FTM 310 Entrepreneurship & New Product Development in Textiles (3 credit hours)
Academic dimensions of the entrepreneurship body of knowledge. Integration of new product development (NPD) process and entrepreneurship in textiles. Critical thinking skills for the textile entrepreneurial mindset. Teams exercise entrepreneurial skills to develop innovative textile products. Write a business plan to take the textile product to market. Multidisciplinary and experiential learning environment is cultivated through in-class activities and online collaboration.

Prerequisite: Junior standing
Typically offered in Fall and Spring

FTM 315 Fashion Product Design (3 credit hours)
Concepts and practices for the design and development of fashion apparel items, beginning with selection of fabric and other raw materials and extending through flat pattern development, pattern engineering, and generation of final garments. Provide techniques for development of styled patterns, which address issues of body measurements, body shape, comfort and fit.

Prerequisite: FTM 217 and FTM 219
Typically offered in Fall and Spring

FTM 317 Computer-Aided-Design for Apparel (3 credit hours)
Introduction to the operation of industry design software for apparel & other sewn products. Euphoria and/or Artworks visual design programs, Gerber Accumark or Lectra pattern design programs, and other programs used by the industry to create, market and/or visualize products will be taught. Peripheral equipment essential to the design process will be included.

Prerequisite: FTD 215 or Corequisite: FTM 315
Typically offered in Fall and Spring

FTM 318 Fashion Development Processes (3 credit hours)
The principles of apparel manufacturing including computerization of the design; marker making and production areas; spreading and cutting technology; apparel assembly systems; production systems evaluations; fusing and pressing; production capacity; and quality evaluations.

Prerequisite: FTM 317
Typically offered in Fall and Spring

FTM 320 Retail Merchandising in Fashion and Textiles (3 credit hours)
An in-depth study of textile product merchandising and its functions, focusing on a comprehensive approach to textile product merchandising that links manufacturing and retailing to the consumer through the merchandising process. Textile merchandising as a process is studied in newly restructured consumer-centric businesses and textile product strategy needed for employees to function successfully in today's global, integrated world of merchandising.

Prerequisite: FTM 220
Typically offered in Fall only

FTM 380/TT 380 Management and Control of Textile and Apparel Systems (3 credit hours)
Management approaches, practices and basic economic considerations in the development, production and distribution of industrial and consumer textile and apparel products.

Prerequisite: FTM 217
Typically offered in Fall only

FTM 382 Brand Management in Textiles and Apparel (3 credit hours)
This course builds on the introduction of the basic concepts introduced in FTM 282 by providing an in-depth examination of the major theories and concepts associated with brand management and brand marketing. Included is the identification and analysis of major strategic tools used for brand management and marketing activities by firms across the integrated textile complex. Students will be assigned practical application projects that require utilization of academic knowledge with industry application.

Prerequisite: FTM 282 and (EC 201 or ARE 201)
Typically offered in Fall and Spring

FTM 384 Visual Merchandising Principles and Management (3 credit hours)
Study and application of techniques in the effective display of merchandise, from fiber to finished product. The focus of the course placed on the integration of textile and apparel product characteristics, target market characteristics and the latest merchandising technology and concepts.

Prerequisite: Junior standing or higher, FTM 217, Corequisite: FTM 382
Typically offered in Spring only

FTM 385 Fashion and the Consumer (3 credit hours)
This course focuses on consumer decision process for textile products, including the study of environmental, individual, psychological and marketing influences on behavior of consumers in the textile consumption process. Further examination will include influences on the process, including fashion theories, the mass media, demographics and psychographics, and societal trends. Current development and research in the textile consumer decision process are reviewed.

Prerequisite: FTM 217, FTM 282
Typically offered in Fall, Spring, and Summer

FTM 387 Textile Brand Communications & Promotions (3 credit hours)
Examines the utilization of textile brand marketing communication and promotion tools to build, maintain or expand a brand's value in the textile complex marketplace. Includes examination of principles and theories for Integrated Brand Marketing (IBMC) and how these strategies and tactics are used within the textile complex advance brand positioning. Knowledge of IBMC will be demonstrated via case studies, examination and textile industry-related application projects. FTM Majors Only

Prerequisite: FTM 382
Typically offered in Fall and Spring

FTM 400 Major Fashion Designers (3 credit hours)
Study of fashion designers from the early 1800s to the present. Emphasis will be placed on historical and cultural events that may have influenced the work of fashion designers during the time and trends that have emerged. Of specific interest will be major historical and current fashion designers that have had an international influence on US fashion merchandise. An additional focus of the course will be on the career path of major fashion designers. A study of haute couture and pret-a-porter will be conducted to provide insight into special management issues.

GEP Visual and Performing Arts
Typically offered in Spring and Summer

FTM 415 Fashion Product Development (3 credit hours)
Fashion product development for specific target markets. Line production using various methods of generating patterns for mass-produced apparel with emphasis on "flat pattern" design techniques. Relationship of body configuration to pattern shape, specifications to garment size and fit, standards for judging fit, distinctions between ease and style fullness, and design analysis procedures are included.

Prerequisite: FTM 318
Typically offered in Fall and Spring

FTM 416 The Fashion Industry (3 credit hours)
Planning and sourcing of fashion apparel products to meet the needs of the consumer. Emphasis is placed on the role of the merchandiser and merchandising function together with the measures of performance required by the fashion businesses. The interactions of the merchandiser with the functions of marketing, design, development and sourcing during pre-production are studied with respect to successful sourcing. Sourcing is studied from the requirements of compliance, product quality, cost, and manufacturing capability.

Prerequisite: FTM220, FTM282, and Senior standing
Typically offered in Fall and Spring

FTM 420 Retail Buying in Fashion and Textiles (3 credit hours)
Overview and analysis of the components of buying and selling products at he retail level. Management of profit factors to improve performance in textile merchandising driven organizations. Analysis of the practices, procedures and systems that track textile merchandising decisions and aid in meeting profit goals. The course consists of an integrated framework that applies merchandising theory and mathematical processes to textile retail problems.

Prerequisite: FTM 220 and FTM 282 and Junior Standing
Typically offered in Fall and Spring

FTM 431 Quality Management and Control In Textile Manufacturing (3 credit hours)
Principles of quality and process management and control in textile/apparel manufacturing with emphases in quality management systems, quality costs, statistical control chart procedures, process capability, acceptance sampling, and optimal process and product design and improvement methods.

Prerequisite: TT 221, TT 252, TT 331, and ST 361 or BUS 350

FTM 460 Textile Market Research (3 credit hours)
Data from textile and apparel industry firms are utilized to explore the role of marketing research in managerial decision-making within the textile and apparel industry, and allow students to develop basic skills in the market research process (problem identification to final reporting). Topics included are problem formulation, research design, data collection (instruments and sampling), and data analysis techniques (qualitative and quantitative).

Prerequisites: FTM 382 and (ST 311, ST 361, or ST 370)
Typically offered in Spring and Summer

FTM 480/TT 480 Operations Management Decisions for Textiles (3 credit hours)
Quantitative techniques for decision making and management in the textile complex. Applications include vendor selection, plant location, retail inventory management, forcasting demand, project management, and logistics planning. Techniques covered include simulation, PERT/CPM, mathematical modeling.

Prerequisite: TT/FTM 380 and ACC 210 and ST 311 or ST 370 and ((MA 131 and 132) or MA 141)
Typically offered in Fall only

FTM 481 Product Costing in the Textile and Apparel Industry (3 credit hours)
Capstone course covering cost issues in yarn manufacturing, fabric formation, finishing, apparel production and retail operations. Traditional and activity-based costing systems will be addressed. Relevance of costing to managerial decisions as well as cost reduction strategies will be emphasized.

Typically offered in Spring and Summer

FTM 482 Global Brand Management in Textiles and Apparel (3 credit hours)
An applied textile marketing course that integrates textile product development, brand management, and global marketing. This course provides an overview of the global textile and apparel industries, their distribution channels and markets---with positioning the US textile, apparel, and retail industries in the global competitive environment. The course includes diverse textile end uses, including apparel, nonwovens, home textiles, transportation textiles and medical textiles. Development and implementation strategies of launching textile products in the global marketplace are analyzed.

Prerequisite: FTM 382
Typically offered in Fall, Spring, and Summer

FTM 483 Global Trade & Sourcing (3 credit hours)
This course provides students with an understanding and appreciation of the global textile and apparel market. Included is the explanation and guidance in understanding the uniqueness of textile and apparel regulations in global trade. Students willlearn global sourcing strategies and the identification and analysis of major strategic decisions used in global sourcing, as impacted by global trade dynamics. Students will be assigned practical application projects that require utilization of academic knowledge with industry application.

Prerequisite: FTM 282 and EC 201 or ARE 201 or EC 205
Typically offered in Fall and Spring

FTM 484 Strategic Planning and Decision Making in the Textile and Fashion Industries (3 credit hours)
The course provides a framework for understanding and analyzing strategic planning and decision making in the textile and apparel supply chain, from fiber through retail. It integrates theory and practice through lectures, case studies, and exercises to provide students an understanding of the competitive dynamics in the textile industry, including structural and behavioral components and the role of entrepreneurship.

Prerequisite:BUS 320 or FTM/TT 380, and TT 221 or equivalent
Typically offered in Fall and Summer

FTM 485/TT 485 Textile Computer Integrated Enterprise (3 credit hours)
Survey of information technology in textile and apparel industries. Topics discussed include: computer aided design (CAD); computer aided manufacturing (CAM); computer aided engineering (CAE); material handling systems; automation and robotics; logistics and warehousing systems; retail product tracking, and Internet resources.

Prerequisite: TT/FTM 380
Typically offered in Fall only

FTM 486/TT 486 Supply Chain Management in the Textile Industry (3 credit hours)
Study of the operations necessary to produce and distribute a product, starting with the procurement of the raw material used in making the goods and ending with the delivery of the finished product. Topics covered include approaches to solving problems in manufacturing, sourcing, transportation logistics, and retail operations within the Integrated Textile Complex. Credit cannot be given for both TAM486 and MT386.

Prerequisite: TT/FTM 380
Typically offered in Spring only

FTM 487 Human Resource Management and Leadership in the Textile and Fashion Industries (3 credit hours)
This course will cover strategic human resource management topics as they apply to the integrated textile industry complex. Principles of situational leadership applicable to the textile and fashion industries will be discussed as well.

Prerequisite: Senior standing
Typically offered in Fall and Spring

FTM 490 Development Projects in Textile and Apparel Management (1-3 credit hours)
Directed research in Textile and Apparel Management through experimental, theoretical and literature studies in textile and apparel-related problems. Courses may be taken twice provided projects are different subject matter.

Prerequisite: Junior standing and 2.75 GPA
Typically offered in Fall, Spring, and Summer

FTM 491 Special Topics in Textile and Apparel Management (1-4 credit hours)
Special topics related to textile and apparel management.

Prerequisite: Senior standing

FTM 494 International Industrial Internship in Textile Management (3 credit hours)
Professional level work experience in textile management abroad, relating academic training, international textile management and technology to industrial practice under professional guidance. Grading based on written report and oral presentation. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: At least FL 202 for internships in non-English speaking countries, Minimum GPA 2.5, Junior standing
Typically offered in Fall and Spring

FTM 497 Senior Fashion Collection Studio (6 credit hours)
Advanced fashion product design. Design and production of a "collection" using various methods of generating patterns for garments, such as flat pattern, draping, and CAD techniques. Relationships of body configuration and fabrication to garment design. Emphasis on ideation, creativity, communication, theme development, fit, quality, and exhibition of a fashion collection. Work culminates in a Fashion show or Static exhibition format.

Prerequisite: FTM 318
Typically offered in Fall and Spring

FTM 499 Textile Senior Project (4 credit hours)
This is a project based course to be taken in the last semester of the Senior year. In this capstone course the students work in cross-functional teams to research and solve applied problems in textile related fields. The results of the projects will be presented formally at the end of the semester. Course should be taken in the last semester of the Senior year. It cannot be substituted by other project courses.

Prerequisite: Senior standing

Feed Mill (FM)

FM 272 Swine Feed Mill Management (1 credit hours)
Principles of feed manufacturing, equipment operation, feed and ingredient quality assurance and regulatory compliance in a modern feed milling operation. Overview of feed mill regulations and safety.

Prerequisite: ANS 150 or ANS 260 or Equivalent Restriction: Restricted to non-ANS (Animal Science) students. ANS students cannot take the course for credit.
Typically offered in Fall only

FM 425/PO 425/NTR 525/FM 525/ANS 525/PO 525/NTR 425/ ANS 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

FM 426/PO 426 Feed Manufacturing Technology Laboratory (1 credit hours)
Laboratory associated with feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture. PO/ANS/FM 425 is a required course for the Poultry Science Technology Concentration (TPS); the Feed Milling Minor (FEM); and the Feed Mill Certificate.

Corequisite: PO 425 or ANS 425 or FM 425 and FEM minor or 11PLTRYBS
Typically offered in Spring only

FM 460/FM 560 Feed Mill Operations and Leadership (3 credit hours)
Principles and current practices of modern feed mill operations. Topics include managing employees, team building, safety, budgets, regulations, and key performance indicators.

Prerequisite: ANS 425 or FM 425 or PO 425
Typically offered in Spring only

FM 480 Feed Quality Assurance & Formulation (3 credit hours)
Introduction to the principles of ingredient and feed quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of approved suppliers, ingredient specifications, feed manufacturing procedures, and formulation based on dynamic ingredient matrices.

Prerequisite: PO(ANS) 425
Typically offered in Fall only

FM 490 Feed Science Seminar (1 credit hours)
Exploration of topics related with current and future potential to influence the feed industry. Guest lectures from feed industry leaders and university representatives will include: vertically integrated and commercial feed production, current research topics, government regulations, trade organizations, and quality assurance.

Typically offered in Fall only

FM 494 Feed Mill Learning Experience (1 credit hours)
Hands-on laboratory teaching students how to safely operate feed mill equipment and manufacture feed using a computer system.

Prerequisite: PO(ANS) 425
Typically offered in Fall, Spring, and Summer

FM 525/ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425/ NTR 525 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

FM 560/FM 460 Feed Mill Operations and Leadership (3 credit hours)
Principles and current practices of modern feed mill operations. Topics include managing employees, team building, safety, budgets, regulations, and key performance indicators.

Prerequisite: ANS 425 or FM 425 or PO 425
Typically offered in Spring only

FM 580/PO 580 Feed and Ingrdient Quality Assurance (3 credit hours)
The course will teach students the principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

FM 594 Advanced Feed Mill Practicum (1 credit hours)
This course will teach students the principles of operating a modern feed mill. Students will receive ingredients, grind grain, manufacture feed, and perform quality checks on finished feed products. Students will complete safety, quality assurance, and feed processing training units as part of their training.

Prerequisite: NTR(FM) 525
Typically offered in Fall and Spring

FM 706/NTR 706 Vitamin Metabolism (3 credit hours)
Structures, chemical and physical properties, functions, distribution, absorption, transport, metabolism, storage, excretion, deficiencies, and toxicity of vitamins in humans and domestic animals. Interactions between vitamins and other factors affecting vitamin metabolism or bioavailability as well as the nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leukotrienes. Application of knowledge will include critical review of scientific literature, experimental design, and formulation of vitamin supplements.

Prerequisite: ANS(NTR,PO) 415 and BCH 453
Typically offered in Fall only

FM 790/NTR 790 Advanced Feed Formulation (3 credit hours)
Principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

Fiber and Polymer Science (FPS)

FPS 696 Summer Thesis Res (1 credit hours)

FPS 710/TC 710 Science of Dye Chemistry, Dyeing, Printing and Finishing (3 credit hours)
The primary course purpose is to gain a strong fundamental understanding of the chemistry and technology of preparation, dyes, dyeing and finishes. Emphasis will be on the chemistry of different bleach activators, surfactants, photophysics and photochemistry of FWAs, modulations of dyes structures to influence color, tinctorial strength, light fastness, wash fastness and aggregation. Chemistry of different dye classes will be studied with emphasis on structure-property relationships and dye-fiber interactions. Dyeing isotherms (Nernst and Langmuir), kinetics of dyeing with emphasis on derivation of Nernst and Langmuir based on thermodynamics and kinetics principles will be covered with practical examples of dyeing at different temperature and how to calculate thermodynamic parameters of dyeing (entropy, standard affinity and isotherm constants of Nernst and Langmuir). Chemistry of different finishes, including soil release, chemistry of flame retardants and mechanisms of flame retardancy, antimicrobial and water and oil repellency, will be covered with emphasis on structure-property relationships.

Prerequisite: Graduate Standing and C or better in CH221 or CH225 and CH223 or CH227
Typically offered in Fall and Spring

FPS 750/TTM 750 Advances in Fabric Formation, Structure, and Properties (3 credit hours)
The course covers different aspects of the processing of yarns to products (braided, knitted, woven, and their composites) and the interrelation between the production mechanics and structure, geometry and properties of fiber assembly. Topics in the field are assigned and each student is expected to thoroughly study the topics and write critical papers based on structured assignments and specific questions. Conduct projects from concept to fabric formation, analyses, and evaluation.

Prerequisite: TT 550 or TT 551 (or TT 451) or equivalent
Typically offered in Spring only

FPS 770 Advances in Polymer Science (3 credit hours)
This course provides an overview of the unique features of polymer materials that distinguish them from those composed of small-molecules or atoms (Polymer Physics) and the connections between their detailed molecular structures and their properties which produce distinctions between them (Polymer Chemistry).

Restriction: Graduate Standing in Fiber and Polymer Science, Textile Chemistry, Textile Engineering, Material Science and Engineering, Chemical Engineering, Chemistry and Physics, or by permission of the instructor.
Typically offered in Fall only

FPS 792 Special Topics in Fiber Science (1-6 credit hours)

FPS 801 Seminar (1 credit hours)
Typically offered in Fall and Spring

FPS 830 Independent Study (1-3 credit hours)
Typically offered in Fall and Spring

FPS 876 Special Project in Fiber and Polymer Sciences (1-12 credit hours)
Typically offered in Fall only

FPS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FPS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FPS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

FPS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Financial Mathematics (FIM)

FIM 500 Career Development for Quants (3 credit hours)
Enhance your professional and career development skills while you are in the Financial Math program with seminar topics on networking, LinkedIn, resumes, interviews, presentations and business writing tips. Learn about workplace etiquette and business ethics. You will also gain resources and important industry information from guest speakers and alumni. Become Base SAS Certified and Bloomberg Certified, and gain hands-on experience with these tools by participating in group and individual projects.Course includes one or more projects that expose students to applications in the area of financial mathematics. Students that wish to develop SAS programming skills are encouraged to take ST 555/556.

Must be in the Masters of Financial Mathematics program.
Typically offered in Fall only

FIM 528/MA 528/ECG 528 Options and Derivatives Pricing (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.

Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only

FIM 547/MA 547 Stochastic Calculus for Finance (3 credit hours)
This course explores stochastics calculus with its applications in pricing and hedging problems for financial derivatives such as options. Topics to be covered in the course include 1) discrete and continuous martingales, 2) Brownian motions and Ito's stochastic calculus, and 3) Black-Scholas framework for financial derivatives pricing and hedging.

Prerequisite: FIM 528 and MA(ST) 546
Typically offered in Spring only

FIM 548/MA 548 Monte Carlo Methods for Financial Math (3 credit hours)
Monte Carlo (MC) methods for accurate option pricing, hedging and risk management. Modeling using stochastic asset models (e.g. geometric Brownian motion) and parameter estimation. Stochastic models, including use of random number generators, random paths and discretization methods (e.g. Euler-Maruyama method), and variance reduction. Implementation using Matlab. Incorporation of the latest developments regarding MC methods and their uses in Finance.

Prerequisites: (MA 421 or ST 421), MA 341, and MA 405
Typically offered in Spring only

FIM 549/MA 549 Financial Risk Analysis (3 credit hours)
This course focuses on mathematical methods to analyze and manage risks associated with financial derivatives. Topics covered include aggregate loss distributions, extreme value theory, default probabilities, Value-at-Risk and expected shortfall, coherent risk measures, correlation and copula, applications of principle component analysis and Monte Carlo simulations in financial risk management, how to use stochastic differential equations to price financial risk derivatives, and how to back-test and stress-test models.

Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/ST 413)
Typically offered in Spring only

FIM 590 Special Topics in FIM (1-6 credit hours)
Special Topics in FIM

FIM 601 Seminar in Financial Mathematics (1 credit hours)
Seminar in Financial Mathematics

Prerequisite: FIM 500
Typically offered in Fall and Spring

FIM 610 Special Topics in Financial Mathematics (1-6 credit hours)
Special Topics in Financial Mathematics

FIM 620 Special Problems in FIM (1-6 credit hours)
Special Problems in FIM

FIM 650 Internship in Financial Mathematics (1-9 credit hours)
The internship experience provides the students the opportunity to use quantitative financial mathematics in a workplace under the supervision of a practitioner. Links academic theory to practice. Develop a heightened awareness of workplace issues as they relate to the student's chosen career path. Clarify and/or confirm professional direction. An internship or project is required of all students in the Masters of Financial Mathematics Program. Restricted to students in the Masters of Financial Mathematics.

Must be a student registered in the Masters of Financial Mathematics program.
Typically offered in Fall, Spring, and Summer

FIM 675 Project in Financial Mathematics (1-3 credit hours)
The project provides the students the opportunity to apply quantitative financial mathematics to a problem of practical interest under the supervision of faculty and/or practitioners. Links academic theory to applications. Examine a practical problem from financial mathematics using marketplace data. Approach solutions to the problem considering aspects of quantitative risk and/or optimal returns. Methods and models will be drawn from academic courses and other sources. Restricted to students in the Masters of Financial Mathematics.

Must be a student registered in the Masters of Financial Mathematics program.
Typically offered in Fall, Spring, and Summer

FIM 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
Non-Thesis Masters Continuous Registration - Half Time Registration

Typically offered in Spring only

FIM 689 Non-Thesis Masters Continuous Registration - Full Time Registration (3 credit hours)
Non-Thesis Masters Continuous Registration - Full Time Registration

Typically offered in Fall and Spring

FIM 693 Master's Supervised Research (1-9 credit hours)
Master's Supervised Research

Typically offered in Fall, Spring, and Summer

Fisheries & Wildlife Sciences (FW)

FW 221 Conservation of Natural Resources (3 credit hours)
This course examines the importance of natural resources and their role in the progress of human civilization. Physical, biological and ecological principles are described that underlie sustainability of natural resources, particularly as these relate to the consequence of human impacts as resources are used to meet societal needs. The course emphasizes renewable natural resources, the importance of habitat, and a broadly-international context. The course has an optimistic perspective that life on Earth can and will be better in the future if we learn and practice good resource management today.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall and Spring

FW 293 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FW 294 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FW 311 Piedmont Wildlife Ecology and Management (3 credit hours)
This 3-week course will involve relationships of wildlife and habitat, the use of GIS and GPS, use of new technology (PIT tags, radio telemetry), and field identification of habitats and animals. This course is taught off-campus at Hill Forest. It is a 3 week residential camps with side trips and overnight trips. Class meets all day for 3 weeks. Additional charge for room and board. Students must provide their own transportation to Hill Forest. Junior standing in one of the following: FOM, NRE, SFW, SFF, SZO, ESC.

Typically offered in Summer only

FW 312 Fisheries Techniques and Management (1 credit hours)
Field exercises in aquatic environments emphasizing assessment of habitat, fish, invertebrates, plants, and ecological relationships to form the basis of describing and solving management dilemmas. Taught off-campus at Hill Forest. 5 day residential camp. Local travel required to various aquatic ecosystems. Additional charges for room and board.

Corequisite: FW 311 and FW 313
Typically offered in Summer only

FW 313 Mountain Wildlife Ecology and Management (1 credit hours)
Visit different mountain communities along an elevation gradient from 2,000 to 6,000 feet and observe changes in plant and animal communities. Discuss wildlife and fisheries management issues, interact with agency personnel responsible for managingmountain fisheries and wildlife. One-week field trip to the North Carolina mountains. Additional charges for room and board.

Corequisite: FW 311 and FW 312
Typically offered in Summer only

FW 314 Coastal Ecology and Management (1 credit hours)
Hands-on study of the fishery and wildlife resources associated with North Carolina coastal plain habitats. These habitats will include estuarine, ocean, longleaf pine savanna, pocosin, and Carolina bays. Common techniques and concepts used in terrestrial, marine, and estuarine ecology and management will be taught. Field identification of habitats, animals, and plants. Use of multiple sampling gear including bottom trawl, beam trawl, beach seine, gill nets, and coverboards. Use of water quality measurement equipment. This course meets all day for 1 week off-campus at CMAST in Morehead City, NC. Additional charge for room and board and boat rental. Students must provide their own transportation to CMAST.

Prerequisite: BIO 181
Typically offered in Summer only

FW 333 Conservation Biology in Practice (3 credit hours)
An introductory course designed to focus on the scientific fundamentals of conservation biology, including population dynamics, extinction and its causes, metapopulations, modeling, population viability analysis, the design and management of protected areas, rare species management, and captive breeding and release programs. Students will participate in active learning exercises, projects, and debates. Projects will require students to make their own arrangements for transportation to field locations within Wake County.

Prerequisite: FW 221 or PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 353 Wildlife Management (3 credit hours)
Historical development of Wildlife Management from anecdotal, observational practices to modern, scientific approaches used around the world. Principles of population analysis, management, protection and conservation of animals, particularly those of conservation, aesthetic, sport or food values in urban, rural and wilderness areas. Ethics of hunting and trapping. Contradictory objectives challenging modern wildlife managers.

R: Sophomore Standing
Typically offered in Fall only

FW 373 Vertebrate Natural History (3 credit hours)
This course provides an introduction to the natural history of vertebrates, including fish, amphibians, reptiles, birds, and mammals. The emphasis is on systematics, identification, and natural history of each vertebrate group.

Prerequisite: BIO 360 or PB 360
Typically offered in Spring only

FW 403 Urban Wildlife Management (3 credit hours)
Issues facing wildlife in urbanizing landscapes and the general courses of action to minimize the negative effects of urbanization on native wildlife. Large-scale planning and zoning for roads, developments and open space; meso-scale planning and landscaping of new neighborhoods and other developments; and small-scale landscaping for backyard habitats. Coexistence between wildlife and humans in urban environments and management of wildlife damage to human property.

Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Fall only

FW 404 Wildlife Habitat Management (3 credit hours)
Relationships between forest and wildlife management and the effects of silvicultural systems on wildlife. Species-habitat requirements, forest wildlife management techniques, and forest-wildlife policies and economics.

Prerequisite: Junior standing
Typically offered in Fall only

FW 405 Tropical Wildlife Ecology (3 credit hours)
This course provides an overview of tropical wildlife ecology and management, sustainable land use, and local culture. The course addresses the challenges of natural resource conservation in a developing country and the sustainable approaches that may be used to conserve natural resources there. Various methods to sample wildlife will be employed during the visit to a tropical country (Ecuador, Nicaragua, etc.), but emphasis will be on the use of mist nets in long-term bird monitoring program. Expenses associated with this course are the responsibility of the student. Requires instructor approval. Students register for this course through the Study Abroad Office.

Typically offered in Spring only

FW 411/FW 511 Human Dimensions of Wildlife and Fisheries (3 credit hours)
Study of human interactions with wildlife and fisheries, including principles important for understanding and addressing wildlife management and conservation challenges. Discussions of wildlife at the urban fringe, human attitudes towards hunting and fishing, and the public trust approach to wildlife management are included.

Juniors and Seniors Only
Typically offered in Spring only

FW 415 Professional Development in Fisheries, Wildlife, and Conservation Biology (1 credit hours)
This course provides guidance for students in the fall semester of their senior year in preparation for graduate school or a career in the field of Fisheries, Wildlife, and Conservation Biology. Junior or Senior standing.

Typically offered in Fall only

FW 444/FW 544 Mammalogy (3 credit hours)
The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One weekend field trip planned. One independent field research project is required. Graduate students will prepare a full written report of their research projects, which will not be required of the undergraduates.

Prerequisite: PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 445 Human Dimensions of Conservation Biology in the Bahamas (3 credit hours)
This course examines the fundamental concepts, problems, and methods regarding human dimensions of conservation biology in The Bahamas. Combining lecture, lab, and fieldwork, students directly experience the process of science, with students conducting semester-long, group research projects tackling important unanswered questions involving conservation biology in The Bahamas. Gaining first-hand experience at the interface of basic and applied sciences, students will spend eight weeks on campus and two weeks in the largely undeveloped Andros Island in The Bahamas, home to the third largest coral reef in the world and over 1.5 million acres of national parks.

Prerequisite: One 200-level or higher course in BIO, ES, ET, FOR, FW, NR, PB, PRT, or ZO.
Typically offered in Summer only

FW 453 Principles of Wildlife Science (4 credit hours)
Principles and applications of population dynamics and biology to the management of terrestrial vertebrates. Predicting population levels, composition and growth rates with and without management constraints. Strategies for wildlife conservation, utilization, and enhancement. Laboratories stress the collection and analysis of data, and often meet in outdoor environments.

Prerequisite: FW 353 and ST 311
Typically offered in Spring only

FW 460/FW 560 International Wildlife Management and Conservation (3 credit hours)
An international perspective on wildlife management and conservation through investigation and comparison of historical events, policies, international conservation organizations and transfrontier conservation areas. Fundamental principles necessaryin managing the African savannah ecosystem, protected areas and game ranches. Identifying global biomes, zoogeography and the impacts of ecotourism.Cannot receive credit for both FW 460/560.

Prerequisite: Junior standing and above.
Typically offered in Spring only

FW 465/FW 565 African Ecology and Conservation (4 credit hours)
This course provides an international perspective on desert ecology, the African savanna ecosystem, African wildlife ecology and management. In addition, the management of a large national park of international importance, conservation of predators and their conflict with humans, and international tourism are discussed. Various sampling techniques are practiced during field work. A combination of lectures, field lectures, field work, field excursions, data analyses and home work form an integral part of the course.

Prerequisite: One 200-level or higher course in ES, ET FOR, FW, NR, PB, PRT, or ZO
GEP Global Knowledge, GEP Natural Sciences
Typically offered in Summer only

FW 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

FW 493 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FW 494 Independent Study in Fisheries, Wildlife, and Conservation Biology (1-6 credit hours)
Independent Study for Fisheries, Wildlife, and Conservation Biology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FW 495 Special Topics in Fisheries and Wildlife Science (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

FW 511/FW 411 Human Dimensions of Wildlife and Fisheries (3 credit hours)
Study of human interactions with wildlife and fisheries, including principles important for understanding and addressing wildlife management and conservation challenges. Discussions of wildlife at the urban fringe, human attitudes towards hunting and fishing, and the public trust approach to wildlife management are included.

Juniors and Seniors Only
Typically offered in Spring only

FW 515/AEC 515 Fish Physiology (3 credit hours)
The biology of fishes: physiology, anatomy, endocrinology, behavior and genetics. Designed especially for graduate students in fisheries. Several trips to research laboratories taken.

Typically offered in Fall only

FW 544/FW 444 Mammalogy (3 credit hours)
The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One weekend field trip planned. One independent field research project is required. Graduate students will prepare a full written report of their research projects, which will not be required of the undergraduates.

Prerequisite: PB 360 or BIO 360 or FOR 260
Typically offered in Fall only

FW 553 Principles Of Wildlife Science (3 credit hours)
The principles of wildlife management and their application studied in the laboratory and in the field.

Prerequisite: BO 360 or ZO 260
Typically offered in Spring only

FW 560/FW 460 International Wildlife Management and Conservation (3 credit hours)
An international perspective on wildlife management and conservation through investigation and comparison of historical events, policies, international conservation organizations and transfrontier conservation areas. Fundamental principles necessaryin managing the African savannah ecosystem, protected areas and game ranches. Identifying global biomes, zoogeography and the impacts of ecotourism.Cannot receive credit for both FW 460/560.

Prerequisite: Junior standing and above.
Typically offered in Spring only

FW 565/FW 465 African Ecology and Conservation (4 credit hours)
This course provides an international perspective on desert ecology, the African savanna ecosystem, African wildlife ecology and management. In addition, the management of a large national park of international importance, conservation of predators and their conflict with humans, and international tourism are discussed. Various sampling techniques are practiced during field work. A combination of lectures, field lectures, field work, field excursions, data analyses and home work form an integral part of the course.

Prerequisite: One 200-level or higher course in ES, ET FOR, FW, NR, PB, PRT, or ZO
GEP Global Knowledge, GEP Natural Sciences
Typically offered in Summer only

FW 586/AEC 586 Aquaculture (3 credit hours)
Biological and general principles of aquaculture. Emphasis on the present status of aquaculture, species involved, techniques employed, and problems encountered. Discussion of recent advances in research and development and identification of areas of future research and development.

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing
Typically offered in Spring only

FW 587/AEC 587 Aquaculture Laboratory (1 credit hours)
Methods and techniques of cultivating aquatic organisms. Field trips and reports on local hatcheries and facilities required. (Three to four overnight field trips taken on week days to coastal areas, state hatcheries, and private hatcheries; students responsible for shared room costs and their meals. Four field trips also taken on laboratory day within driving range of Raleigh.)

Prerequisite: BO 360 or ZO 260 or Graduate standing or Senior standing, Corequisite: ZO 586
Typically offered in Fall only

FW 595 Special Topics in Fisheries and Wildlife Sciences (1-6 credit hours)
Special topics in various aspects fisheries and wildlife sciences are developed under the direction of a graduate faculty member. Also used to test and develop new courses.

Typically offered in Fall, Spring, and Summer

FW 602 Seminar In Wildlife Management (1 credit hours)
Current topics and issues in wildlife biology and management. Students select and research topics, give seminars and lead group discussions.

Typically offered in Fall only

FW 610 Special Topics in Fisheries and Wildlife Sciences (1-6 credit hours)
Special topics in various aspects of fisheries and wildlife science are developed under the direction of a graduate faculty member. Also used to develop new courses.

Typically offered in Fall, Spring, and Summer

FW 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FW 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FW 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FW 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

FW 720 Epidemiology of Wildlife Diseases (3 credit hours)
Concepts related to infectious disease outbreaks in free-ranging species of wildlife. Numerous examples of wildlife diseases will be used to illustrate factors affecting host-agent-environment interactions in fish, amphibians, birds, and both aquatic and terrestrial mammals. Enrollment in the Fisheries and Wildlife graduate program or Masters of Veterinary Public Health program; clinical residents or veterinary students at the College of Veterinary Medicine.

FW 726/AEC 726 Quantitative Fisheries Management (3 credit hours)
Current methods for assessment and management of exploited fish populations, including sampling methods, data analysis and modeling. A required research paper or project.

Typically offered in Fall only

FW 730 Ethics in Fisheries and Wildlife Sciences (2 credit hours)
Students will explore historical and current thinking concerning the search for truth about natural systems, and the complex ethics scientists and practitioners who operate in the public sector must consider. Standards of professional and ethical behavior specific to Fisheries and Wildlife Sciences will be addressed. Faculty will introduce topics and guide discussions; students will give seminars and lead some discussions. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Fall only

FW 801 Issues in Fisheries and Wildlife Sciences Doctoral Seminar (2 credit hours)
Current topics and issues in Fisheries and Wildlife Sciences Research. Students select and research topics, give seminars on Ph.D. proposals, and lead group discussions. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Spring only

FW 802 Seminar in Fisheries and Wildlife (1 credit hours)
Current topics and issues in fisheries and wildlife biology and management. Students select and research topics, give seminars, and lead group discussions. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Fall only

FW 810 Special Topics in Fisheries and Wildlife (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, will explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to dissertation. Also used to develop and test new 800-level courses. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Spring and Summer

FW 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Fall and Spring

FW 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Fall, Spring, and Summer

FW 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Fall, Spring, and Summer

FW 896 Summer Doctoral Dissertation Research (1 credit hours)
Summer Dissertation Research. For doctoral students in Fisheries and Wildlife Sciences.

Typically offered in Summer only

Food Science (FS)

FS 201 Introduction to Food Science (3 credit hours)
Food science is an exciting, multidisciplinary career that draws on chemistry, microbiology, and engineering principles to produce, preserve, and protect the foods that we eat every day. This course is designed to help you understand the journey of foods from "farm to fork", the effect of diet on human health, and the laws governing food labeling and marketing. It's science you can eat!

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

FS 231 Principles of Food and Bioprocess Engineering (4 credit hours)
Engineering concepts and their applications to the food and bioprocessing industries. Mass and energy balances and principles related to fluid flow, heat transfer, refrigeration and freezing, psychrometrics, and selected unit operations found in these industries.

Prerequisite: PY 211 or PY 205 and PY 206
Typically offered in Spring only

FS 250 Basics of Food Safety & Quality (3 credit hours)
This course examines the programs that maintain food safety and quality in food processing environments. It is based on international standards for food safety prerequisite programs in food manufacturing. Students will learn how to evaluate and manage pre-requisite programs for food safety. Examples include Good Manufacturing Practices (GMPs), Sanitation Standard Operating Procedures (SSOPs), Sanitation Control Procedures, and Preventive Controls.

Typically offered in Fall and Summer

FS 290 Careers in Food and Bioprocessing Sciences (1 credit hours)
Careers and opportunities related to food and bioprocessing industries and regulatory agencies. Development of professional enhancement skills. Resume preparation, interviewing techniques, leadership development, oral and written communication, and team building. Benefits of undergraduate research, internships, and graduate education.

Typically offered in Fall only

FS 295 Special Topics in Food Science (1-4 credit hours)
Offerings of new or experimental courses in Food Science at the early undergraduate level.

Typically offered in Fall, Spring, and Summer

FS 301/NTR 301 Introduction to Human Nutrition (3 credit hours)
Functions, dietary sources, digestion and absorption, deficiencies and excesses of essential nutrients in humans; dietary guidelines; food labels; the study of diet-disease relationships; the role of diet in heart disease, diabetes, hypertension, osteoporosis; energy balance and weight control; dietary supplement regulation; diet and athletic performance.

Prerequisite: Sophomore standing
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

FS 322/PO 322/ANS 322 Muscle Foods and Eggs (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processedmeat items.

Prerequisite: ZO 160, BIO 181 or BIO 183
Typically offered in Fall only

FS 324/ANS 324 Milk and Dairy Products (3 credit hours)
Introduction to the manufacture of dairy products. Dairy processing procedures from the farm, through the dairy plant, and to the consumer are studied. The course consists of 15 learning modules, three exams, and a project.

Prerequisite: BIO 181 or 183, CH 101
Typically offered in Fall only

FS 325/BBS 325 Introduction to Brewing Science and Technology (3 credit hours)
For centuries brewing has been and remains a vitally important application of fermentation science, both economically and socially. This course will provide a detailed description of the fundamental chemical and biological processes involved in brewing beer, as well as the physical and hygienic aspects of modern beer production. Successful completion of this course will provide students with the understanding of the science and technology underlying the key steps in a commercial brewing process and provide the basic knowledge necessary for an entry level position in a commercial brewery.

Prerequisite: CH 101 and BIO 183 or BIO 181
Typically offered in Spring only

FS 326/BBS 326 Brewing Practices and Analyses (3 credit hours)
This course will provide a hands on learning experience to both complement the classroom lectures offered in BBS/FS 325 and acquaint the student with the equipment and practices encountered in real-world analytical labs of breweries of all scales. The laboratory experience will replicate the sequence of events encountered in actual beer production and illustrate the relevant evaluations and analyses which are concurrent with those processing steps, stressing at each stage not only the execution of the appropriate analytical or testing techniques, but also corrective action that may be taken should undesirable results be obtained.

Prerequisite: BBS/FS 325 Introduction to Brewing Science and Technology
Typically offered in Fall only

FS 330 Science of Food Preparation (3 credit hours)
Basic elements of culinary practices are taught in conjunction with the scientific basis for how flavor, texture, and appearance of foods are created or maintained during food preparation.

Prerequisite: FS 201 and CH 101
Typically offered in Spring only

FS 352 Introduction to Microbiological Food Safety Hazards (3 credit hours)
For non-science students. The course is designed to provide an introduction to the more prominent microbial foodborne safety hazards and their control. Lessons are provided on specific pathogens, their pathogenesis and transmission and the scientific basis for specific control options. In addition, the course provides up-to-date information on current "hot-topics" in food microbiology, including food safety regulations and emerging food safety issues.Course is offered to non-science majors. Students may not receive credit for both FS 352 and FS 405.

Typically offered in Fall and Spring

FS 354 Food Sanitation (3 credit hours)
Discussion of hygienic practices, requirements for sanitation programs, and modern sanitation practices in food processing facilities. At the end of this course, students will have the knowledge to develop and maintain a sanitation program.

Prerequisite: FS/ANS/PO 350 or equivalent HACCP industry experience
Typically offered in Fall and Spring

FS 401/NTR 501/FS 501/NTR 401 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall only

FS 402/FS 502 Chemistry of Food and Bioprocessed Materials (4 credit hours)
The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.

Prerequisite: CH 220 or 221 or 225
Typically offered in Fall only

FS 403 Analytical Techniques in Food & Bioprocessing Science (4 credit hours)
Principles, methods and techniques for quantitative physical and chemical analyses of food, nutraceutical, and pharmaceutical products. Results of analyses evaluated in terms of quality standards and governing regulations.

Prerequisite: FS 402
Typically offered in Spring only

FS 405/MB 405/FS 505/MB 505 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

FS 406/MB 406/FS 506/MB 506 Food Microbiology Lab (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

FS 416/FS 516 Quality Control in Food and Bioprocessing (3 credit hours)
This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.

Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students).
Typically offered in Fall only

FS 421/FS 521 Food Preservation (3 credit hours)
Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.

Prerequisite: FS 231 and FS 405
Typically offered in Fall only

FS 426/BEC 426/BBS 526/FS 526/BEC 526/BBS 426 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

FS 427/BBS 427 Brewing Equipment, Controls and Operations (3 credit hours)
Modern commercial brewing is an equipment and utility intensive endeavor. Emphasis on efficiency, flexibility and sanitation has led to equipment and controls which have vastly improved the volume and consistency of brewery output while also improving safety and the quality of the working environment. In order to manage the transfer of material and energy in the brewing process, individual components within the brewing system, as well holistic function of the brewery environment have been adapted to maximize efficiency. Knowledge of the specific design and operation of these components within the overall system is crucial to the proper functioning of a brewery. The operation of individual components and processes within the brewery will be examined in terms of the physics and engineering principles driving their function. On completion, this course will provide sufficient knowledge of brewery equipment and operations to function successfully in an entry to mid-level position.

Corequisite: BBS 325 or FS 325
Typically offered in Spring only

FS 435/FS 535 Food Safety Management Systems (3 credit hours)
This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system. Students will learn the step-by-step process for developing and implementing food safety plans to ensure food products are safe and wholesome. Students will apply theoretical knowledge as they engage with case studies through interactive videos and virtual reality tours as they practice developing and auditing food safety plans.

Prerequisite: FS 250
Typically offered in Spring only

FS 453/FS 553 Food Laws and Regulations (3 credit hours)
Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies.Credit will not be given for both FS 453 and FS 553.

Prerequisite: Junior standing.

FS 462/HS 462/HS 562/FS 562 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

FS 471 Professionalism & Project Preparation in Food & Bioprocessing Science (1 credit hours)
Discipline-specific professional development: teamwork, problem-solving and communication skills. Resume and interview preparation. Experimental design, literature review, budgeting and planning in preparation for the FS 475 Problems and Design in Food and Bioprocessing Science capstone course.

P: FS 201 and FS 231 and Senior Standing in Food Science or Bioprocessing Science
Typically offered in Fall only

FS 475 Problems and Design in Food and Bioprocessing Science (3 credit hours)
Team approach to problem solving and product/process design and development. Ingredient functionality; formulation, safety, processing, packaging, sensory evaluation, regulatory issues, hazard analysis, critical control points (HACCP), nutritional labeling and other pertinent scientific, technical, marketing and financial aspects. Oral and written presentations are required.

Prerequisite: FS 231, FS 402, FS 405 or BAE(BBS) 425
Typically offered in Spring only

FS 481 Research Experience in Food and Bioprocessing Sciences (3 credit hours)
Students actively engage in a research initiative at the USDA-Agriculture Research Service Food Science Research Unit. Students become familiar with the settings of food science laboratories, conduct literature reviews, manage the basic scientific structure applied to problem solving, are introduced to experimental design and data processing and synthesis to solve complex problems, and understand the unpredictable nature of scientific research. At the end of the course, students will be able to structure an informative public presentation on the results of the study and present their findings to diverse audiences. As part of the learning process students will acquire and/or further develop selected laboratory techniques associated with basic microbiology and chemistry. Course limited to rising juniors and seniors in good standing. Sophomores would need instructor approval to join the course.

Restriction: Juniors and Seniors Only
Typically offered in Summer only

FS 492 Professional Internship Experience in Food Science (1-3 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by the student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

FS 493 Research Experience in Food Science (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 42 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Food Science prior to the start of the experience. To gain approval, a student must submit the completed FS 493 contract and have it approved by his/her research supervisor, academic advisor and the FS 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

FS 494 Teaching Experience in Food Science (1-3 credit hours)
This course provides an opportunity for students to gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Food Science prior to the start of the experience. To gain approval, a student must submit the completed FS 494 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

FS 495 Special Topics in Food Science (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

FS 501/NTR 401/FS 401/NTR 501 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall and Summer

FS 502/FS 402 Chemistry of Food and Bioprocessed Materials (4 credit hours)
The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. Basic elements of molecules, such as structure and reactive groups, are presented in regard to how they affect the properties of foods and pharmaceuticals. Reactions such as Maillard browning and lipid oxidation are discussed regarding mechanisms, products and controlling processes. Laboratory experiments emphasize basic concepts discussed in lecture and provide a practical working knowledge of select analytical equipment.

Prerequisite: CH 220 or 221 or 225
Typically offered in Fall only

FS 505/MB 505/FS 405/MB 405 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

FS 506/MB 506/FS 406/MB 406 Food Microbiology Lab (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

FS 516/FS 416 Quality Control in Food and Bioprocessing (3 credit hours)
This course provides an overview of the principles of quality management, assurance and control in the food and bioprocessing industries. The objectives are for students to be able to identify government regulations, private industry standards, and customer expectations that are relevant to food and bioprocessing, apply root cause analysis methodologies, apply and evaluate control charts for monitoring process control for variables and attributes, conduct process capability analyses, apply statistical hypothesis testing, and design producer and/or customer-centered sampling plans. Lab activities alternate between guest speakers from industry and exercises in which students develop their abilities to apply computer programs to solve quality problems. Note: students may not earn credit for taking both FS 416 and FS 516.

Restriction: FS, Bioprocessing, PSC, ANS, and NT students. Others may enroll with permission from the instructor. Section 601 is restricted to true distance education students (not regular term students).
Typically offered in Fall only

FS 520/FSA 520 Pre-Harvest Food Safety (3 credit hours)
Dairy, beef, swine, poultry, and seafood modules: production, government regulation of products, use of antimicrobials in production, and the emergence of resistant human pathogens. Field fruit and vegetable crops section: hazards in food includingpesticide residues and philosophy and practice of organic farming and public's perception of food and biotechnology.

Typically offered in Fall only

FS 521/FS 421 Food Preservation (3 credit hours)
Food preservation methods. Emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical and organoleptic changes to products. Application of preservation schemes to the development of an overall processing operation.

Prerequisite: FS 231 and FS 405
Typically offered in Fall only

FS 522 Food Packaging (3 credit hours)
This course deals with the history of packaging, types of packages, and packaging equipment, factors involved in choice of package, aseptic packaging, shelf-life studies, modified atmospheric packaging, active packaging, packaging for e-commerce, automatic identification and data capture, closures, seal integrity, tamper evidence, graphic design & printing, distribution, labeling, environmental issues, regulatory agencies and stipulations, new frontiers in packaging, and packaging resources. Restricted to students enrolled in (or degree received) in the Food Bioprocessing and Nutrition Sciences Program or a closely related program such as the Biological & Agricultural Engineering Program.

Typically offered in Spring only

FS 526/BEC 526/BBS 426/FS 426/BEC 426/BBS 526 Upstream Biomanufacturing Laboratory (2 credit hours)
This course is an introduction to current food manufacturing practice (CGMP) as applied to the growth of microbial cells in bioreactors. Hands-on experience is obtained in the operation and control of 30 liter bioreactors to study agitation, oxygen transfer, cleaning, sterilization, media preparation and the growth of recombinant E. coli for protein production. Credit will not be awarded in both BBS 426 and BBS/FS 526. This is an eight week course.

Prerequisite: (MB 351 and FS 231) CHE/BEC 463
Typically offered in Fall and Spring

FS 530/FSA 530 Post-Harvest Food Safety (3 credit hours)
Background on the current issues and developments associated with post-harvest food safety, including biological, chemical, and physical food safety hazards. Additionally, regulations governing food safety and consumer perceptions.

Prerequisite: MB 351/352
Typically offered in Fall only

FS 535/FS 435 Food Safety Management Systems (3 credit hours)
This course teaches students how to develop and implement food safety management systems. It begins with the Hazard Analysis and Critical Control Points (HACCP) system and then teaches the Hazard Analysis and Risk-Based Preventive Controls (HARPC) system. Students will learn the step-by-step process for developing and implementing food safety plans to ensure food products are safe and wholesome. Students will apply theoretical knowledge as they engage with case studies through interactive videos and virtual reality tours as they practice developing and auditing food safety plans.

Prerequisite: FS 250
Typically offered in Spring only

FS 540/FSA 540 Food Safety and Public Health (3 credit hours)
Issues and developments related to the relationship between food safety and public health, including emerging foodborne pathogens; virulence and pathogenicity; foodborne toxins; epidemiological techniques used in the investigation of foodborne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

Prerequisite: MB 351/352
Typically offered in Spring only

FS 550 Food Industry Study Tour (2 credit hours)
The Food Industry Study Tour is designed to give students a behind the scenes look into the food processing industry. This week-long trip, will allow students to travel throughout North Carolina and the Southeast region, touring various meat, dairy, seafood, produce, cereal, snack food, beverage, and candy production facilities. The class trip will run 5-6 days during the week of Spring Break holiday. Enrollment is limited and subject to the permission of the instructor.

Typically offered in Spring only

FS 553/FS 453 Food Laws and Regulations (3 credit hours)
Federal and state laws and regulations, and case law history affecting food production, processing, packaging, marketing, and distribution of food and food products. History of food law, enactment of laws and regulations, legal research, and regulatory agencies.Credit will not be given for both FS 453 and FS 553.

Prerequisite: Junior standing.

FS 554/NTR 554 Lactation, Milk, and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

FS 555/NTR 555 Exercise Nutrition (3 credit hours)
Metabolism of macro- and micronutrients as affected by exercise and physical activity. Effects of dietary patterns, specific foods, dietary supplements and ergogenic aids on sports performance. Reading and discussion of current literature and individual or group projects.

Prerequisite: NTR 400/500
Typically offered in Spring only

FS 557/NTR 557 Nutraceuticals and Functional Foods (3 credit hours)
This course evaluates the weight of evidence from peer-reviewed scientific literature relating food bioactives, whole foods, and diets to disease prevention, athletic performance, and cognitive development/enhancement. Data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims. Key concepts include dose-response, signal transduction, and the use of advanced technologies such as genomics, proteomics and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.

Typically offered in Fall only

FS 562/FS 462/HS 462/HS 562 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

FS 567 Sensory Analysis of Foods (3 credit hours)
Techniques of sensory analysis and data interpretation, a crucial aspect of food science research and marketing both at the academic and industrial levels. Fundamental and applied aspects of sensory analysis of foods, including human senses, descriptive analysis, scaling, consumer testing and sensory-instrumental relationships.

Prerequisite: Statistics 511
Typically offered in Spring only

FS 580/FSA 580 Professional Development and Ethics in Food Safety (1 credit hours)
Professional development and thics related to food safety. Foof safety communications to lay-audiences and the media; the ethical frontier between science/policy and science/profit. Planned student and faculty presentations as well as guest lectures on current topical issues.

Prerequisite: FSA 520 or FSA 530 or FS 540
Typically offered in Spring only

FS 591 Special Problems In Food Science (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 592 Special Research Projects in Food Science (1-6 credit hours)
Typically offered in Spring only

FS 620 Special Problems In Food Science (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 623 Special Research Problems In Food Science (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

Typically offered in Spring only

FS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

FS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

FS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

FS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FS 725/MB 725 Fermentation Microbiology (3 credit hours)
Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.

Prerequisite: BCH 451, MB 351
Typically offered in Spring only

FS 741 Thermal Processing of Foods (3 credit hours)
Fluid flow, heat transfer, food preservation, kinetics of chemical, microbiological, and enzymatic reactions, decimal reduction time, pasteurization, sterilization, cook value, process lethality, canning of foods, thermal process evaluation, qualityconsiderations, optimization, shelf-life studies, thermal processing equipment, hot-fill, extended shelf-life products, heat exchanger design, pumps, sanitation, aseptic processing, minimal processing, NFPA bulletins, alternative processing technologies, regulatory issues, HACCP.

Prerequisite: FS 231
Typically offered in Spring only

FS 780 Seminar In Food Science (1 credit hours)
Preparation and presentation of scientific papers, progress reports and research and special topics of interest in foods.

Typically offered in Fall and Spring

FS 785/BAE 785 Food Rheology (3 credit hours)
Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing.

Prerequisite: FS 231 or MAE 314
Typically offered in Fall only

FS 791 Special Problems in Food Science (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.Credits Arranged.

Typically offered in Fall, Spring, and Summer

FS 792 Special Research Projects in Food Science (1-6 credit hours)
Credits Arranged

Typically offered in Fall only

FS 820 Special Problems In Food Science (1-6 credit hours)
Analysis of scientific, engineering and economic problems of current interest in foods. Problems designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

FS 823 Special Research Problems In Food Science (1-6 credit hours)
Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy.

Typically offered in Spring only

FS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking wirtten and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

FS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Food Science (FSA)

FSA 520/FS 520 Pre-Harvest Food Safety (3 credit hours)
Dairy, beef, swine, poultry, and seafood modules: production, government regulation of products, use of antimicrobials in production, and the emergence of resistant human pathogens. Field fruit and vegetable crops section: hazards in food includingpesticide residues and philosophy and practice of organic farming and public's perception of food and biotechnology.

Typically offered in Fall only

FSA 530/FS 530 Post-Harvest Food Safety (3 credit hours)
Background on the current issues and developments associated with post-harvest food safety, including biological, chemical, and physical food safety hazards. Additionally, regulations governing food safety and consumer perceptions.

Prerequisite: MB 351/352
Typically offered in Fall only

FSA 540/FS 540 Food Safety and Public Health (3 credit hours)
Issues and developments related to the relationship between food safety and public health, including emerging foodborne pathogens; virulence and pathogenicity; foodborne toxins; epidemiological techniques used in the investigation of foodborne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

Prerequisite: MB 351/352
Typically offered in Spring only

FSA 580/FS 580 Professional Development and Ethics in Food Safety (1 credit hours)
Professional development and thics related to food safety. Foof safety communications to lay-audiences and the media; the ethical frontier between science/policy and science/profit. Planned student and faculty presentations as well as guest lectures on current topical issues.

Prerequisite: FSA 520 or FSA 530 or FS 540
Typically offered in Spring only

Foreign Language - Chinese (FLC)

FLC 101 Elementary Chinese I (3 credit hours)
Introduction to Modern Standard Chinese. Emphasis on speaking and listening with an introduction to reading, writing and Chinese culture.

Corequisite: FLC 103
Typically offered in Fall only

FLC 102 Elementary Chinese II (3 credit hours)
Continuation of basic skills. Emphasis on speaking and listening with some reading, writing and Chinese culture.

Corequisite: FLC 104
Typically offered in Spring only

FLC 103 Elementary Chinese I Conversation (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 101. Students will gain practice at using their speaking skills in a variety of basic social situations.

Corequisite: FLC 101
Typically offered in Fall only

FLC 104 Elementary Chinese II Conversation (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 102. Students are encouraged to use their speaking skills in a variety of typical social situations. Special attention is given to naturalness of speech.

Prerequisite: FLC 101 and FLC 103; Corequisite: FLC 102
Typically offered in Spring only

FLC 201 Intermediate Chinese I (3 credit hours)
Continuation of basic skills. Greater emphasis on reading, writing and Chinese cultural traditions.

Prerequisite: FLC 102; Corequisite: FLC 203
Typically offered in Fall only

FLC 202 Intermediate Chinese II (3 credit hours)
Continuation of basic skills. Focus on reading, writing, Chinese cultural traditions and patterns of behavior.

Corequisite: FLC 204
GEP Global Knowledge
Typically offered in Spring only

FLC 203 Intermediate Chinese I Conversation (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 201. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to naturalness of speech and intonation.

Prerequisite: FLC 102 and FLC 104; Corequisite: FLC 201
Typically offered in Fall only

FLC 204 Intermediate Chinese II Conversation (1 credit hours)
Supplements conversational practice and handwriting skills for FLC 202. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to naturalness of speech and intonation.

Prerequisite: FLC 201 and FLC 203; Corequisite: FLC 202
Typically offered in Spring only

FLC 301 Intermediate Chinese III (3 credit hours)
Last of the foundation courses in Chinese. Continued practice in speaking and understanding Chinese with new emphasis on writing and on the reading of cultural and literary texts.

Prerequisite: FLC 202
Typically offered in Fall only

FLC 302 Intermediate Chinese IV (3 credit hours)
Continued practice in speaking and understanding Chinese with greater emphasis on reading and writing. Continued study of cultural and literary texts.

Prerequisite: FLC 301
Typically offered in Spring only

FLC 351 Modern Chinese Popular Culture (3 credit hours)
Introduction to basic aspects of cultural practices and production in Chinese society, including consumer culture, education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Reading and analysis of representative works of modern Chinese visual and print culture including literature, film, advertising, digital media and consumer products with attention to cultural analysis as well as to historical and cultural background.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLC 401 Advanced Chinese: Readings in Literature and Social Sciences (3 credit hours)
Continued training in the foundations of Chinese language, with emphasis on nuances of written Chinese. This course introduces advanced Chinese language students to modern literature and social science texts. Students read and analyze some of the finest works of 20th c. Chinese intellectuals, authors and social critics. The class explores a wide range of prose forms, styles, and subject matter. Emphasis will be placed on developing advanced-level proficiency in reading & writing, and on literary analysis & discussion of cultural & historical contexts.

Prerequisite:FLC 302
Typically offered in Fall only

FLC 402 Advanced Chinese: Readings in Literature and Science (3 credit hours)
Continued training in the foundations of Chinese language, with emphasis on nuances of written Chinese. This course introduces advanced Chinese language students to modern literature and science texts. Students read and analyze some of the finest works of 20th c. Chinese intellectuals, authors and proponents of scientific advancement as well as original scientific research in Chinese. The class explores a wide range of prose forms, styles, and subject matter. Emphasis will be placed on developing advanced-level proficiency in reading & writing, and on literary analysis & discussion of cultural & historical contexts.

Prerequisite:FLC 302
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

Foreign Language - English (FLE)

FLE 100 Introduction to Academic Writing (4 credit hours)
For non-native speakers of English. Intensive introduction to critical writing and reading in academic contexts. Exploration of writing processes and academic literacy skills: interpreting assignments; comprehending, analyzing, and evaluating college-level texts; inventing, drafting, and revising; seeking, providing, and responding to constructive feedback; collaborating effectively under varied learning models. Extensive writing practice and individualized coaching. Attention to grammar and conventions of standard written English. Intended as preparation for FLE 101.Only for non-native speakers of English. Requires C- or better. Credit for FLE 100 is not allowed if student has prior credit for FLE 101

Typically offered in Fall and Spring

FLE 101 Academic Writing and Research (4 credit hours)
For non-native speakers of English intensive instruction in academic writing and research. Basic principles of rhetoric and strategies for academic inquiry and argument. Instruction and practice in critical reading, including the generative and responsible use of print and electronic sources for academic research, adapted for non-native speakers. Exploration of literate practices across a range of academic domains, laying the foundation for further writing development in college. Continued attention to grammar and conventions of standard written English. Satisfies freshman English requirements. Successful completion of FLE 101 requires a C- or better. Credit for FLE 101 is not allowed if the student has already fulfilled the first-year writing requirement.

Typically offered in Fall and Spring

FLE 201 Oral Communication in English for International Students (3 credit hours)
Oral communication in English; active and interactive speaking skills, listening comprehension and reading. Specific tasks in spoken English such as communicating information, making inquiries, requests and complaints. Individual and group work inthe form of oral reports, role play, presentations, etc. Listening to lectures and note taking skills.

Typically offered in Fall and Spring

FLE 400 American English Pronunciation for International Students (3 credit hours)
Intensive pronunciation practice for non-native speakers of English. Emphasis on improved intelligibility through practice on English rhythm, stress and intonation. Individual and class work on vowel and consonant difficulties.

Typically offered in Fall and Spring

FLE 401 Advanced Oral Communication in English for International Students (3 credit hours)
Oral communication in English; pronunciation skills, reading, aural comprehension and oral skills; communication strategies and cross-cultural communication; individual and group activities such as presenting information, teaching a class, fielding questions and leading a discussion.

Typically offered in Fall and Spring

FLE 402 Advanced Written Communication in English for International Students (3 credit hours)
Written communication skills for graduate students; integrated writing tasks focusing on writing, reading, grammar and comprehension, specifically geared to the needs of research students and teaching assistants. Reading, critical analysis and synthesis of written material such as journal articles, research reports, etc.

Typically offered in Fall and Spring

Foreign Language - French (FLF)

FLF 101 Elementary French I (3 credit hours)
First in a four-course sequence to develop language skills. Oral and written practice in classroom and language laboratory. Readings in French culture and civilization.

Typically offered in Fall, Spring, and Summer

FLF 102 Elementary French II (3 credit hours)
Continuation of FLF 101 with intensive practice in spoken French. Readings in French culture and civilization.

Prerequisite: FLF 101
Typically offered in Fall, Spring, and Summer

FLF 110 Accelerated Elementary French (3 credit hours)
Content of FLF 101 and 102, at an accelerated pace, for students with previous study of French (1-2 years in high school) who placed into the course based on results of the NC State French Placement Test. Includes a refresher of 101 material beforecovering 102 material. Development of skills in listening, speaking, reading, writing and understanding Francophone cultures. Significant amount of work outside of class. Fulfills the FL 102 requirement.

Prerequisite: Placement into this course determined by The Department of Foreign Languages and Literatures Placement Test: http://sasw.chass.ncsu.edu/fl/place.htm
Typically offered in Fall and Spring

FLF 201 Intermediate French I (3 credit hours)
Third of four consecutive courses to develop skills of speaking, listening, reading and writing. Readings and discussions of French culture, civilization and literature.

Prerequisite: FLF 102 or FLF 110
Typically offered in Fall, Spring, and Summer

FLF 202 Intermediate French II (3 credit hours)
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of France and the Francophone world.

Prerequisite: FLF 201 or FLF 212
GEP Global Knowledge
Typically offered in Fall and Spring

FLF 212 French: Language, Culture, and Technology (3 credit hours)
A study of the language structures and vocabulary necessary for an intermediate level of communication in French together with cultural and technological issues of our global society, in the context of the French-speaking world and the European Union. Students are responsible for providing their own transportation for required field trip. Fulfills the FLF 201 requirement.

Prerequisite: FLF 102 or FLF 110
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

FLF 301 Survey of French Literature from the Middle Ages through the Enlightenment (3 credit hours)
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

Prerequisite: An advanced language skills course (FLF 308 or FLF 310 or FLF 315) or FLF 202 with permission of instructor.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLF 302 Survey of French Literature from Romanticism to the Contemporary Period (3 credit hours)
Reading and discussion of representative works with attention to literary analysis as well as to historical and cultural background.

Prerequisite: An advanced language skills course (FLF 308, 310, 315) or FLF 202 with consent of instructor.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 306 French Business Communication (3 credit hours)
Study of major forms of written and oral business communication used in the French-speaking world. Extensive work with current, culturally authentic materials. Emphasis on development of practical communicative skills, with special attention to cross-cultural comparisons of French and American business practices and modes of communication.

Prerequisite: FLF 202

FLF 307 Business French (3 credit hours)
Business French vocabulary and concepts with emphasis on cultural differences and their importance in the new global village business world.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 308 Advanced Conversation: Contemporary French Cultures (3 credit hours)
Conversation and reading emphasizing idiomatic and practical usage with attention to contemporary civilization and cultures of the French speaking world. Emphasis on social structures, political features, events, world views and modes of communication.

Prerequisite: FLF 202
Typically offered in Fall and Spring

FLF 309 French Phonetics and Pronunciation (3 credit hours)
A study of the oral production of standard French with the aim of improving pronunciation, fluency and skill in communication. Extensive oral practice through conversation and phonetics.

Prerequisite: FLF 202
Typically offered in Fall and Spring

FLF 310 Advanced Written Communication (3 credit hours)
An in-depth study of French written communication at the advanced level, including the more advanced aspects of the French grammar with extensive writing practice serving a variety of practical communicative needs.

Prerequisite: FLF 202
Typically offered in Fall only

FLF 315 French Civilization and Culture (3 credit hours)
French civilization and culture from its origins to the modern period. Reading and discussion of the social, cultural, economic and political structures of France, including its geography, history, music, art and national consciousness.

Prerequisite: FLF 202
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FLF 318 The Heritage of French Cinema (3 credit hours)
Survey of the major contributions of French cinema from its origins to the present. Attention to film as an artistic medium and to the cinematic representation of French history and culture. Reading, discussion, and viewing of films including Un Chien Andalou, La Passion de Jeanne d'Arc, Le Retour de Martin Guerre, La Marseillaise, Les 400 Coups, and Diva.

Prerequisite: 3 hrs. in French at 300 level
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

FLF 321 French Cultures and Contexts (3 credit hours)
An approach to important periods in the history of French culture through the reading of texts by several important writers. Films, slides, painting, music, and the Internet will be included to put the readings in a cultural context.

Prerequisites: FLF 308 and FLF 310
Typically offered in Fall and Spring

FLF 401 French Graduate Reading (3 credit hours)
Basic French grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students' areas of research. Prepares students to take the graduate foreign language certification exam.

Typically offered in Fall only

FLF 411 Approaches to French Translation (3 credit hours)
Intensive practice of translating to and from French a variety of texts selected from the areas of business, law, technology and science, as well as literature and the arts. Focus on Documentation, Research and Translation techniques and ethics.

Prerequisite: at least two French (FLF) 300 level courses

FLF 425/FLF 525 Literature, Cinema and Culture of the Francophone World (3 credit hours)
A study of a number of literary texts and films from across the spectrum of the Francophone world - West Africa, the Maghreb, and the Caribbean. Through these texts and films we will study the diversity of the French colonial empire as well as the different historical, political and cultural effects of colonialism and postcolonialism. Films, videos, internet sites will be used. Course taught in French.

Prerequisite: Junior Standing and one course in French literature.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 492 Seminar in French Studies (3 credit hours)
A small-group study of a topic in literature resulting in either a substantial essay or series of essays by each student. Topics vary each semester.

Prerequisite: Junior standing and 6 hrs in French literature
Typically offered in Fall and Spring

FLF 502 Variety in Language: French (3 credit hours)
Structure and evolution of the French language. A study of language variety in the French-speaking world. Attention to the historical evolution of the language through time, and an analysis of the phonological, morphological and syntactic featuresof modern French. Use of the World Wide Web will enable students to access material from many parts of the Globe.Course taught in French.

Prerequisite: Graduate standing
Typically offered in Spring only

FLF 511 Approaches to French Translation (3 credit hours)
Intensive practice of translating to and from French a variety of texts selected from the areas of business, law, technology and science, as well as literature and the arts. Focus on Documentation, Research and Translation techniques and ethics.Course taught in French. Credit not allowed for both 411 & 511.

Prerequisite: Graduate standing
Typically offered in Fall only

FLF 516 Art and Society in France (3 credit hours)
An overview of the visual arts in France, defined broadly, and their relationship to French society and culture: painting, architecture, photography, cinema, book production, gardens, fashion, cuisine, television, popular culture, and mass media will be studied.Course taught in French.

Typically offered in Spring only

FLF 520 Approaches to Literary Theory and Culture (3 credit hours)
A survey of literary theory in the 20th century with a particular focus on French thought and culture and French literary history. Examines the virtues and pitfalls of these approaches to the study of culture and literature. A course on issues, concepts, theorists and the social, historical and political context in which the theorists are writing. Taught in French. No formal pre-requisites. However, some advanced literature background is recommended.

Restriction: Graduate Standing
Typically offered in Fall only

FLF 521 French Cultures and Contexts (3 credit hours)
Study of important periods in the history of French culture through the reading of key literary texts. Films, slides, painting, music, and the Internet will be included to put the readings in a cultural context. Topics vary. Students cannot get credit for both 421/521.

Prerequisite: Graduate status required for FLF 521
Typically offered in Fall only

FLF 525/FLF 425 Literature, Cinema and Culture of the Francophone World (3 credit hours)
A study of a number of literary texts and films from across the spectrum of the Francophone world - West Africa, the Maghreb, and the Caribbean. Through these texts and films we will study the diversity of the French colonial empire as well as the different historical, political and cultural effects of colonialism and postcolonialism. Films, videos, internet sites will be used. Course taught in French.

Prerequisite: Junior Standing and one course in French literature.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLF 592 Seminar in French Studies (3 credit hours)
Seminar on literary, linguistic, or cultural topic in French studies. Research paper and oral presentation required. Conducted entirely in French. Rotating topics. Credit allowed for both 492 and 592 if topics are distinct.

Prerequisite: At least one 400-level French class or Graduate standing
Typically offered in Fall and Spring

FLF 595 Special Topics in French (3-6 credit hours)
In depth exploration of specialized topics in French literature, culture or language. Also used to test and develop new courses.Course taught in French

Prerequisite: Graduate standing
Typically offered in Fall and Spring

FLF 630 Independent Study in French (1-3 credit hours)
Individualized study in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with the faculty member supervising work.

Typically offered in Spring only

FLF 675 Special Project in French (1-3 credit hours)
Individual project in French language or literature at the graduate level. Topic and mode of study to be determined in consultation with student's project advisory committee within the parameters of specific options.

Prerequisite: Student must be in final semester of his or her program.
Typically offered in Fall and Spring

FLF 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall only

Foreign Language - German (FLG)

FLG 101 Elementary German I (3 credit hours)
The first in a four-course sequence to develop the language skills of listening, speaking, reading, and writing. Emphasis on the acquisition of everyday German and cultural awareness. Active class participation, practice in the language lab and computer lab, and written assignments.

Typically offered in Fall, Spring, and Summer

FLG 102 Elementary German II (3 credit hours)
Second in a four-course sequence to develop the language skills of listening, speaking, reading, and writing. Emphasis on the acquisition of everyday German and cultural awareness. Active class participation, practice in the language lab and computer lab, and written assignments.

Prerequisite: FLG 101
Typically offered in Fall, Spring, and Summer

FLG 201 Intermediate German I (3 credit hours)
The third of four consecutive courses in German. Intensive conversational practice to develop proficiency in speaking and listening, advanced reading and writing skills by learning complex grammatical structures and through the use of authentic texts. Acquisition of cultural knowledge about the German-speaking countries.

Prerequisite: FLG 102
Typically offered in Fall, Spring, and Summer

FLG 202 Intermediate German II (3 credit hours)
Last of four consecutive courses in German. Continued conversational practice to develop proficiency in speaking and listening. Development of advanced writing skills by refining grammatical structures and style through assignments, and of advancedreading skills through the use of cultural and literary texts from the German-speaking countries.

Prerequisite: FLG 201
GEP Global Knowledge
Typically offered in Fall and Spring

FLG 212 German Language, Culture, Science, and Technology (3 credit hours)
Discussion of German, Austrian and Swiss scientific discoveries and technological inventions as well as their impact on global society, such as aspirin, x-rays, printing technology, diesel engine, computer, microchip, television, mp3 format, genetics, and environmental technologies. Also a fourth semester German course, with intensive practice to develop proficiency in intermediate speaking and listening, reading and writing, using materials from scientific and technological disciplines.

Prerequisite: FLG 201
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

FLG 301 Advanced German (3 credit hours)
Review and consolidation of aspects of German grammar and development of writing skills. Listening and speaking practice through group activities and oral reports. Class discussions on topics from the cultures of Germany, Austria, and Switzerland, such as film, history, and the fine arts. FLG 301 and 302 can be taken in random order.

Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Fall only

FLG 302 German Oral and Written Expression (3 credit hours)
Review and practice of spoken and written German using authentic texts and materials from contemporary Germany (short stories, films, and online media). Review of German grammar through conversation, writing, and vocabulary building exercises. Oral reports by students. FLG 301 and 302 can be taken in random order.

Prerequisite: FLG 202 or FLG 212 or a score of 688 on the NC State placement test.
Typically offered in Spring only

FLG 307 Business German (3 credit hours)
Business German vocabulary and terminology. Readings and discussions on current business topics. Special consideration to intercultural communication relative to international business operations.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
Typically offered in Fall only

FLG 311 Introduction to German Translation (3 credit hours)
Introduction to theory, methods, and techniques in translation applied to materials of various fields and professions. Emphasis on written translation.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
Typically offered in Fall only

FLG 315 Germanic Civilization and Culture (3 credit hours)
Culture and civilization of the German-speaking countries. Analysis of the social, economic and political structures of Germany, Austria, and Switzerland. Lectures, reports, conversation. Taught in German.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLG 318 New German Cinema and Beyond (3 credit hours)
Survey of the major contributions to German Cinema from the 1960's to the present day. Attention to film as an artistic medium and to the cinematic representation of German history and culture. Topics covered include Nazism, German Terrorism, former East Germany, debates on the position of minorities in Germany, and German Jewish relations. Taught in German.

Prerequisite: FLG 202 or FLG 212
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

FLG 320 Introduction to German Literature (3 credit hours)
An introduction to reading and analyzing German, Austrian, and Swiss literary texts in their cultural and historical contexts. Discussion of various genres (short story, novel, drama, poetry) formal aspects, literary periods, and a variety of critical approaches. Lectures and much discussion. Oral and written assignments.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLG 323 Twentieth Century German Literature (3 credit hours)
Twentieth century literature from German-speaking countries. Readings of Mann, Kafka, Rilke, Hesse, Durrenmatt, Frisch, Grass, and a variety of poets, or concentration on one or two of these world authors. Lectures and discussions. Oral and written assignments.

Prerequisite: FLG 202 or FLG 212 or equivalent.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLG 325 German Lyric Poetry (3 credit hours)
A historical and interpretative study of the German lyric from the fifteenth into the twentieth century with special attention to the poet's choice of theme, the ways in which that theme is treated, and the relevance of the poem to the human experience.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLG 390 German Studies Topics (3 credit hours)
Presentation of material not available in regular course offerings, or offering of new courses on a trial basis. Course may be offered through videoconferencing with other UNC campuses as an offering of the German Studies Consortium. Content determined by faculty member in consultation with the department's German section coordinator. May be repeated.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.

FLG 398 Independent Study in German (1-6 credit hours)
Individualized study in German language, culture, or literature. Topic, mode of study, and credit hours to be determined in consultation with the faculty member supervising work. Departmental approval required. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: FLG 202 or FLG 212 or placement at 300 level.
Typically offered in Fall, Spring, and Summer

FLG 401 German Graduate Reading (3 credit hours)
Basic German grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students' areas of research. Prepares students to take the graduate foreign language certification exam.

Typically offered in Fall only

FLG 420 Current Issues in German-Language Media (3 credit hours)
Using the internet and a textbook, the course will be constructed from current topics circulated in the German, Austrian and Swiss media, e.g. newspaper websites, radio programs and TV news in streaming video format. Overview of the different news genres, the German-language media scape, and major political, economic, social and cultural issues in the German-speaking countries. Discussion, oral presentations, written assignments.

Prerequisite: Two courses at the FLG 300 level
Typically offered in Fall only

FLG 430 Cultural Artifacts in the German-Speaking Countries (3 credit hours)
Focuse on major cultural achievements in Germany, Austria and Switzerland, including literature, film, art, and music. Topics will vary. Examples are: "Kafka and Modernism", "German/Austrian/Swiss Literature and Film-Adaptations", "German-LanguageOpera", "German Art and Society in the 20th Century", or "The Faust Theme in Literature, Art, and Music". This course is repeatable so long as a different topic is covered each time.

Prerequisite: One FLG 300-level course and one from this list: FLG 315, 316, 318, 320, 323, 325, 390.
Typically offered in Fall only

FLG 440 Green Germany: Nature and Environment in German Speaking Cultures (3 credit hours)
Survey of the long "Green" tradition in German-speaking cultures as reflected in the arts, in literature, and in scientific discoveries that have made Germany, Austria, and Switzerland leaders in development of alternative environmental technologies. Discussion in German of issues such as Romantic nature poetry, industrialization, Nazi attitudes towards nature, deforestation, the Green Party, air and water pollution, waste management, energy production, climate change, transportation systems, green architecture, sustainability, and the latest environmental technologies. Practice and assessment through class debates, group work, writing tasks, student presentations, and a portfolio.

Prerequisite: 3 Hours of 300-Level German
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

FLG 492 Senior Seminar in German Studies (3 credit hours)
Capstone seminar in German literature or culture. Student presentations and either a substantial essay or a series of essays. Topics vary each semester.

Prerequisite: Two 300 level FLG courses on literature or culture or film
Typically offered in Spring only

FLG 499 Internship in Germany, Austria, or German-Speaking Switzerland (1-6 credit hours)
Professional internship in a company or organization in Germany, Austria, or German-speaking Switzerland, with German as the main language of daily operations. Contract between the student, department, and company or organization about content, scope, and requirements. 1-6 credits for an approved internship. Essay describing and evaluating the internship experience in the conext of student's professional development. Students are responsible for their own travel and living expenses. Departmental approval required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Two courses at the FLG 300 level
Typically offered in Fall, Spring, and Summer

Foreign Language - Greek (GRK)

GRK 101 Elementary Greek I (3 credit hours)
Introduction to Classical Greek. Greek alphabet, basic grammar and syntax. Readings based on Greek mythology, philosophy, and literature.

Typically offered in Fall only

GRK 102 Elementary Greek II (3 credit hours)
A second course in Classical Greek, continuing and expanding the work of GRK 101, and completing the study of grammar. Readings from major authors including Herodotus, Thucydides, and Xenophon.

Prerequisite: GRK 101
Typically offered in Spring only

GRK 201 Intermediate Greek I (3 credit hours)
Introduction to Greek prose. Emphasis upon improvement of reading skill through vocabulary acquisition and study of complex grammar. Introduction to Attic dialect through reading Plato, and Koine Greek through reading the New Testament. Examination of the importance of these works to Western literature and culture.

Prerequisite: GRK 102
Typically offered in Fall only

GRK 202 Intermediate Greek II (3 credit hours)
Reading in Homer's Iliad and the New Testament. Techniques of oral poetry. Study of the use of myth, and of the literary and historical significance of the Iliad. Analysis of differences between classical and Koine Greek in the New Testament.

Prerequisite: GRK 201
GEP Global Knowledge
Typically offered in Spring only

GRK 399 Directed Readings in Greek (3 credit hours)
Advanced Greek language course introducing students to research methods in classical studies. Readings may include Plato, Homer, Sophocles, New Testament, or others. May be taken up to two times with different readings for credit.

Prerequisite:GRK 202

Foreign Language - Hindi (FLN)

FLN 101 Elementary Hindi-Urdu I (3 credit hours)
Introduction to standard Hindi-Urdu. Emphasis on speaking and listening, and on reading and writing in the Hindi writing system (Devanagari). Readings in South Asian culture and civilization.

Corequisite: FLN 103
Typically offered in Fall only

FLN 102 Elementary Hindi-Urdu II (3 credit hours)
Continuation of FLN 101. Emphasis on oral communication and reading and writing in the Hindi writing system (Devanagari). Further readings in South Asian culture and civilization.

Prerequisite: FLN 101, Corequisite: FLN 104
Typically offered in Spring only

FLN 103 Elementary Hindi-Urdu I Conversation (1 credit hours)
Required conversational practice for FLN 101. Special attention to individual pronunciation and intonation. Introduction of formal and informal speech. Use of audiovisual materials.

Corequisite: FLN 101
Typically offered in Fall only

FLN 104 Elementary Hindi-Urdu II Conversation (1 credit hours)
Required conversational practice for FLN 102. Extensive use of speaking skills in variety of situations. Attention to supplemental non-verbal communication. Use of audiovisual materials.

Prerequisite: FLN 101, Corequisite: FLN 102
Typically offered in Spring only

FLN 201 Intermediate Hindi-Urdu I (3 credit hours)
Continuation of basic language skills. Further practice of Urdu/Hindi writing systems. Introduction to grammatical divergence of Hindi and Urdu. Readings in South Asian culture and civilization.

Prerequisite: FLN 102, Corequisite: FLN 203
Typically offered in Fall only

FLN 202 Intermediate Hindi-Urdu II (3 credit hours)
Continuation of FLN 201. Further practice of both Hindi/Urdu writing systems. Further distinction of spoken and literary Urdu and Hindi. Further readings in South Asian culture and civilization.

Prerequisite: FLN 201, Corequisite: FLN 204
GEP Global Knowledge
Typically offered in Spring only

FLN 203 Intermediate Hindi-Urdu I Conversation (1 credit hours)
Required conversational practice for FLN 201. Advancement of speaking skills through role playing, interviews, debates. Further Hindi and Urdu non-verbal communication. Use of audiovisual materials, including responses to commercial television and movies.

Prerequisite: FLN 102, Corequisite: FLN 201
Typically offered in Fall only

FLN 204 Intermediate Hindi-Urdu II Conversation (1 credit hours)
Required conversational practice for FLN 202. Refinement of speaking skills through role playing, interviews, debates. Further Hindi and Urdu non-verbal communication. Use of audiovisual materials, including responses to commercial television andmovies.

Prerequisite: FLN 201, Corequisite: FLN 202
Typically offered in Spring only

FLN 301 Twentieth Century Hindi & Urdu Fiction (3 credit hours)
Introduces advanced Hindi-Urdu students to the prose fiction of major Hindi and Urdu literary figures including Munshi Premchand, Saadat Hasan Manto and others. Texts will be provided in both Hindi and Urdu scripts and/or English translation as available.

Prerequisite: FLN 202
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLN 302 Modern Hindi & Urdu Poetry (3 credit hours)
Introduces advanced Hindi-Urdu students to representative works of 19th and 20th century Hindi and Urdu poets and poetic forms. Texts will be provided in both Hindi and Urdu scripts and/or English translation as available.

Prerequisite: FLN 202
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLN 401 Hindi Literature and South Asian Cultural Contexts (3 credit hours)
Selected topics in Hindi literature and/or South Asian literature in Hindi, such as drama in modern South Asia, the twentieth-century novel, literature and the nation, narratives of pain and resistance, gender and social reform. Readings and discussion in Hindi, with emphasis on the examination of formal literary characteristics and the interconnections of texts and relevant South Asian cultural contexts. Topics will be rotated so that students can take this course for credit up to three times.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

Foreign Language - Italian (FLI)

FLI 101 Elementary Italian I (3 credit hours)
Begins the development of a balanced foundation in all four language skills. Concentrates on listening and speaking, emphasizing idiomatic Italian. Short readings in Italian culture and civilization. Class and laboratory practice, written homework.

Typically offered in Fall, Spring, and Summer

FLI 102 Elementary Italian II (3 credit hours)
Continuation of FLI 101 with emphasis on acquisition of oral skills through class practice and use of audio aids. Readings in Italian culture, civilization and literature.

Prerequisite: FLI 101
Typically offered in Fall, Spring, and Summer

FLI 201 Intermediate Italian I (3 credit hours)
Third of four consecutive courses to develop skills of speaking, listening, reading and writing. Readings and discussion of Italian culture, civilization and literature.

Prerequisite: FLI 102
Typically offered in Fall and Spring

FLI 202 Intermediate Italian II (3 credit hours)
Last of four sequential language courses. Increased emphasis on reading and writing. Readings in the literature, culture, and civilization of Italy.

Prerequisite: FLI 201
GEP Global Knowledge
Typically offered in Spring only

FLI 208 Intermediate Italian Conversation (3 credit hours)
Intensive practice in speaking and understanding Italian through role playing, discussion, interviews, and use of audio-visual materials.

Corequisite: FLI 202
Typically offered in Fall and Summer

FLI 308 Italian Reading and Conversation (3 credit hours)
Advanced readings and intensive conversational practice in Italian for students beyond the intermediate level.

Prerequisite: FLI 202
Typically offered in Spring only

FLI 315 Italian Civilization and Culture (3 credit hours)
Italian culture and society from its origins to modern times, including its history, geography and national and regional identities, social images, political and economic structures, and technological and scientific development of the Italian society. As an extension of the classroom students participate in educational experiences such as excursions and Italian cooking classes. Taught in English and as NC State Study Abroad Program in Perugia, Italy.

GEP Global Knowledge, GEP Humanities
Typically offered in Summer only

FLI 318 Italian Society Through Cinema (3 credit hours)
Italian culture and society through cinema from the fascist era to the present. A study of selected films representative of major social-political, ideological, and artistic developments. Weekly film viewings. Taught in Italian.

Prerequisite: FLI 202
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

Foreign Language - Japanese (FLJ)

FLJ 101 Elementary Japanese I (3 credit hours)
Introduction to standard, formal Japanese. Emphasis on speaking and listening skills. Exposure to Japanese culture, reading, and writing.

Corequisite: FLJ 103
Typically offered in Fall only

FLJ 102 Elementary Japanese II (3 credit hours)
Continuation of basic skills. Emphasis on speaking and listening skills; inclusion of Japanese cultural factors in communication. Some reading and writing.

Prerequisite: FLJ 101, Corequisite: FLJ 104
Typically offered in Spring only

FLJ 103 Elementary Japanese I Conversation (1 credit hours)
Supplements conversational practice in FLJ 101. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to correcting and improving pronunciation and intonation.

Corequisite: FLJ 101
Typically offered in Fall only

FLJ 104 Elementary Japanese II Conversation (1 credit hours)
Supplements conversational practice in FLJ 102. Extensive use of speaking skills in a variety of situations. Special attention given to correcting and improving pronunciation and intonation.

Prerequisite: FLJ 101, Corequisite: FLJ 102
Typically offered in Spring only

FLJ 201 Intermediate Japanese I (3 credit hours)
Continuation of basic skills. Greater emphasis on reading and writing. More exposure to Japanese cultural traditions.

Prerequisite: FLJ 102 or FLJ 105, Corequisite: FLJ 203
Typically offered in Fall only

FLJ 202 Intermediate Japanese II (3 credit hours)
Continuation of the learning of the basic skills. Emphasis on reading and writing as well as on spoken Japanese and on cultural patterns of behavior.

Prerequisite: FLJ 201, Corequisite: FLJ 204
GEP Global Knowledge
Typically offered in Spring only

FLJ 203 Intermediate Japanese Conversation (1 credit hours)
Practice in spoken Japanese through use of the language in a variety of situations. Increase vocabulary and develop fluency and ease in the structural patterns of the language.May be repeated for a maximum of three credit hours.

Prerequisite: FLJ 102, Corequisite: FLJ 201, FLJ 202 or FLJ 301
Typically offered in Fall only

FLJ 204 Intermediate Japanese II Conversation (1 credit hours)
Supplemental intermediate conversational practice. Drills and situational exercises to build oral proficiency with patterns introduced in FLJ 202.

Corequisite: FLJ 202
Typically offered in Spring only

FLJ 301 Intermediate Japanese III (3 credit hours)
Continued study of Japanese language. Primary emphasis on spoken Japanese, but attention also given to reading, writing and culture.

Prerequisite: FLJ 202
Typically offered in Fall only

FLJ 302 Intermediate Japanese IV (3 credit hours)
Continued training in the foundations of Japanese language. Primary emphasis on spoken Japanese, with increased attention to reading and writing.

Prerequisite: FLJ 301
Typically offered in Spring only

FLJ 342 Classical Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from earliest recorded times through the sixteenth century. Examples from major eras and genres (folktales, poetry, philosophy, fictional narrative, theater, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward traditional literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 344 Early Modern Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from 1600 to late Nineteenth Century. Examples from major periods and genres (novels, poetry, philosophy, dram, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposed. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 345 Modern Japanese Literature in Translation (3 credit hours)
A survey in literature in Japan from the Meiji Era through World War Two. Examples from major periods and genres (novels, poetry, philosophy, drama, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 351/ANT 351 Contemporary Culture in Japan (3 credit hours)
Introduction to basic aspects of cultural practices in Japanese society, including education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Students will develop an understanding of the interrelationships between language and culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 401 Advanced Japanese I (3 credit hours)
Continued training in the foundations of Japanese language, with emphasis on complex verb forms. Increased attention to reading and writing.

Prerequisite: FLJ 302
Typically offered in Fall only

FLJ 402 Advanced Japanese II (3 credit hours)
Elaboration on grammatical forms learned in the previous courses with applications in reading and writing, combined with more sophisticated vocabulary and idioms and attention to development of natural reading skills.

Prerequisite: FLJ 401
Typically offered in Spring only

Foreign Language - Japanese (FLJ)

FLJ 101 Elementary Japanese I (3 credit hours)
Introduction to standard, formal Japanese. Emphasis on speaking and listening skills. Exposure to Japanese culture, reading, and writing.

Corequisite: FLJ 103
Typically offered in Fall only

FLJ 102 Elementary Japanese II (3 credit hours)
Continuation of basic skills. Emphasis on speaking and listening skills; inclusion of Japanese cultural factors in communication. Some reading and writing.

Prerequisite: FLJ 101, Corequisite: FLJ 104
Typically offered in Spring only

FLJ 103 Elementary Japanese I Conversation (1 credit hours)
Supplements conversational practice in FLJ 101. Students are encouraged to use their speaking skills in a variety of situations. Special attention is given to correcting and improving pronunciation and intonation.

Corequisite: FLJ 101
Typically offered in Fall only

FLJ 104 Elementary Japanese II Conversation (1 credit hours)
Supplements conversational practice in FLJ 102. Extensive use of speaking skills in a variety of situations. Special attention given to correcting and improving pronunciation and intonation.

Prerequisite: FLJ 101, Corequisite: FLJ 102
Typically offered in Spring only

FLJ 201 Intermediate Japanese I (3 credit hours)
Continuation of basic skills. Greater emphasis on reading and writing. More exposure to Japanese cultural traditions.

Prerequisite: FLJ 102 or FLJ 105, Corequisite: FLJ 203
Typically offered in Fall only

FLJ 202 Intermediate Japanese II (3 credit hours)
Continuation of the learning of the basic skills. Emphasis on reading and writing as well as on spoken Japanese and on cultural patterns of behavior.

Prerequisite: FLJ 201, Corequisite: FLJ 204
GEP Global Knowledge
Typically offered in Spring only

FLJ 203 Intermediate Japanese Conversation (1 credit hours)
Practice in spoken Japanese through use of the language in a variety of situations. Increase vocabulary and develop fluency and ease in the structural patterns of the language.May be repeated for a maximum of three credit hours.

Prerequisite: FLJ 102, Corequisite: FLJ 201, FLJ 202 or FLJ 301
Typically offered in Fall only

FLJ 204 Intermediate Japanese II Conversation (1 credit hours)
Supplemental intermediate conversational practice. Drills and situational exercises to build oral proficiency with patterns introduced in FLJ 202.

Corequisite: FLJ 202
Typically offered in Spring only

FLJ 301 Intermediate Japanese III (3 credit hours)
Continued study of Japanese language. Primary emphasis on spoken Japanese, but attention also given to reading, writing and culture.

Prerequisite: FLJ 202
Typically offered in Fall only

FLJ 302 Intermediate Japanese IV (3 credit hours)
Continued training in the foundations of Japanese language. Primary emphasis on spoken Japanese, with increased attention to reading and writing.

Prerequisite: FLJ 301
Typically offered in Spring only

FLJ 342 Classical Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from earliest recorded times through the sixteenth century. Examples from major eras and genres (folktales, poetry, philosophy, fictional narrative, theater, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward traditional literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 344 Early Modern Japanese Literature in Translation (3 credit hours)
A survey of literature in Japan from 1600 to late Nineteenth Century. Examples from major periods and genres (novels, poetry, philosophy, dram, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposed. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 345 Modern Japanese Literature in Translation (3 credit hours)
A survey in literature in Japan from the Meiji Era through World War Two. Examples from major periods and genres (novels, poetry, philosophy, drama, miscellaneous narrative, etc.) will be considered, with attention to historical and cultural contexts, as well as to contemporary scholarship and approaches toward the literature. Examples from literature outside Japan will be included for comparative purposes. No prior knowledge of Japanese required: Readings and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 351/ANT 351 Contemporary Culture in Japan (3 credit hours)
Introduction to basic aspects of cultural practices in Japanese society, including education, work life, family relationships, everyday religious practices, aesthetic traditions, national identity, and gender. Students will develop an understanding of the interrelationships between language and culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLJ 401 Advanced Japanese I (3 credit hours)
Continued training in the foundations of Japanese language, with emphasis on complex verb forms. Increased attention to reading and writing.

Prerequisite: FLJ 302
Typically offered in Fall only

FLJ 402 Advanced Japanese II (3 credit hours)
Elaboration on grammatical forms learned in the previous courses with applications in reading and writing, combined with more sophisticated vocabulary and idioms and attention to development of natural reading skills.

Prerequisite: FLJ 401
Typically offered in Spring only

Foreign Language - Latin (LAT)

LAT 101 Elementary Latin I (3 credit hours)
Beginning course in Classical Latin, emphasizing elementary grammatical form and basic syntax. Readings based on brief selections from Roman authors, including Cicero and Catullus.

Typically offered in Fall only

LAT 102 Elementary Latin II (3 credit hours)
Continuation of Latin 101. Completion of the study of elementary grammar. Readings from a variety of Latin authors, including texts on mythological themes.

Typically offered in Spring only

LAT 201 Intermediate Latin I (3 credit hours)
Introduction to Latin prose and poetry. Emphasis on increased reading skill. Review of grammar fundamentals and exposure to new and more complex syntax. Examination of cultural significance of readings.

Prerequisite: LAT 102
Typically offered in Fall and Summer

LAT 202 Intermediate Latin II (3 credit hours)
Lyric poetry of Catullus and Horace emphasizing vocabulary, syntax, and techniques of Latin verse. Traditions and the evolution of lyric poetry and the social role of the Roman poet.

Prerequisite: LAT 201
Typically offered in Spring only

LAT 399 Directed Readings in Latin (3 credit hours)
Advanced Latin language course introducing students to research methods in classical studies. Readings may include Vergil, Ovid, Livy, Cicero, or others. May be taken up to two times with different readings for credit.

Prerequisite:LAT 202
Typically offered in Spring only

Foreign Language - Persian (PER)

PER 101 Elementary Persian I (3 credit hours)
This is the first Persian course in the sequence and is intended for students with little or no knowledge of the language. The course uses an integrated-skills approach (speaking, listening, reading, writing and culture) and a 300-word vocabulary level.

C: PER 103
Typically offered in Fall only

PER 102 Elementary Persian II (3 credit hours)
In this second course of Persian, students learn how to talk about their daily routines and spare time activities, likes and dislikes, and build a more complex language form. They are expected to ask and answer questions on the same topics as well. Throughout the course they learn common phrases and cultural perspectives which help them create a more natural interaction with speakers of Persian. Persian-Farsi is the language base, with Tehrani accent. This is an 800-word level class and ACTFL level of ILR 0+.

P: PER 101/103; C: PER 104
Typically offered in Spring only

PER 103 Elementary Persian I Conversation (1 credit hours)
Required conversational and cultural practice for PER 101. Students will gain practice at using their speaking skills in a variety of basic social situations.

C: PER 101
Typically offered in Fall only

PER 104 Elementary Persian II Conversation (1 credit hours)
Required conversational and cultural practice for PER 102. Students will develop their speaking skills in a variety of basic social situations.

C: PER 102; P: PER 101/103
Typically offered in Spring only

PER 201 Intermediate Persian I (3 credit hours)
Persian 201 is the third semester (beginning of second-year) in Persian. It deepens the students' familiarity with the syntax of the literary language of Persia and expands their command of the spoken vernacular of Iran through exposure to more varied and sophisticated communicational contexts. An intermediate textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

Prerequisite: Elementary Persian 102, or instructor's permission
Typically offered in Fall only

PER 202 Intermediate Persian II (3 credit hours)
Persian 202 is the fourth semester, which completes the intermediate level (second year) in Persian. It further deepens the students' familiarity with the syntax of the literary language of Persia and expands their command of the spoken vernacular of Iran through exposure to more varied and sophisticated communicational contexts. It deals principally with the acquisition of the conversation register of the language, which differs considerably from the formal written style. An intermediate textbook with grammar explanations in English is supplemented with tapes and videos of authentic language and culture used in situational communication.

Prerequisite: Elementary Persian (PER 201) or instructor's permission
GEP Global Knowledge
Typically offered in Spring only

Foreign Language - Portuguese (FLP)

FLP 101 Elementary Portuguese I (3 credit hours)
Introduction to the fundamentals of Brazilian Portuguese: pronunciation, comprehension, and spoken syntax and grammar.

Typically offered in Fall only

FLP 102 Elementary Portuguese II (3 credit hours)
Continuation of the essentials of Brazilian Portuguese. Further stress on pronunciation and comprehension and introduction of reading and writing skills.

Prerequisite: FLP 101
Typically offered in Spring only

FLP 201 Intermediate Portuguese I (3 credit hours)
The third level of Portuguese with special attention to speaking, reading, writing and developing a cultural awareness of the cultural heritage of the Portuguese-speaking peoples of Portugal, Brazil and Portuguese-speaking Africa.

Prerequisite: FLP 102 or placement in course
Typically offered in Fall only

FLP 401 Brazilian Portuguese for Spanish Speakers (3 credit hours)
A one semester on-line intensive introductory course to Brazilian Portuguese for Spanish speakers taught in Spanish focusing on the development of: 1) Reading Comprehension in Brazilian Portuguese; 2) Basic translation skills: Spanish>Portuguese>Spanish; 3) Colloquial writing skills in Brazilian Portuguese; 4) Basic speaking ability in Brazilian Portuguese. This course is open to undergraduate, graduate and extension students with a formal knowledge of Spanish who fulfill the prerequisite. Instructor approval required.

Prerequisite: Native/Heritage Spanish Speaker or FLS 202 or Equivalent and Instructor's Approval
Typically offered in Fall and Spring

Foreign Language - Russian (FLR)

FLR 101 Elementary Russian I (3 credit hours)
First in a four-course sequence to develop language skills in Russian. Oral and written practice in the classroom and language laboratory and attention to Russian cultural heritage.

Typically offered in Fall only

FLR 102 Elementary Russian II (3 credit hours)
Emphasis on acquisition of basic oral skills, with complementary reading and writing exercises and attention to Russian cultural heritage.

Prerequisite: FLR 101
Typically offered in Spring only

FLR 201 Intermediate Russian I (3 credit hours)
Basic Russian language skills continued. More emphasis given to writing and essential conversational practice. Intermediate level readings in Russian literature and culture. Class and laboratory practice; written assignments.

Prerequisite: FLR 102
Typically offered in Fall only

FLR 202 Intermediate Russian II (3 credit hours)
Advanced aspects of Russian syntax through study of text. Continued attention to conversational practice and vocabulary building.

Prerequisite: FLR 201
GEP Global Knowledge
Typically offered in Spring only

FLR 303 Russian Literature in Translation: The Nineteenth Century (3 credit hours)
A study of the great Russian writers of the nineteenth century. Examination of peculiarly Russian as well as the universal aspects of this literature. All readings, lectures and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLR 304 Russian Literature in Translation: The Twentieth Century (3 credit hours)
A study of major Russian writers of the twentieth century. Examination of peculiarly Russian as well as the universal aspects of this literature. All readings, lectures and discussions in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLR 318 Russian Cinema and Society (3 credit hours)
Russian culture and society through cinema. A study of selected films representative of major social-political, ideological, and artistic developments. Weekly film screenings. No knowledge of Russian required.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

Foreign Language - Spanish (FLS)

FLS 101 Elementary Spanish I (3 credit hours)
For students with little or no background or previous study of Spanish or those who place into course via Spanish placement exam. Development of communicative abilities within an integrated skill approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Typically offered in Fall, Spring, and Summer

FLS 102 Elementary Spanish II (3 credit hours)
Continuation of FLS 101. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 101
Typically offered in Fall, Spring, and Summer

FLS 105 Intensive Elementary Spanish (6 credit hours)
An intensive course equivalent to FLS 101 plus FLS 102. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Typically offered in Fall and Spring

FLS 110 Accelerated Elementary Spanish (3 credit hours)
Contents of FLS 101 and FLS 102 at an accelerated pace, for students placed into the course based on results of the Spanish placement test. Development of communicative abilities within an integrated skills approach (speaking, listening, reading, writing). Introduction to the cultures of the Spanish-speaking world. Includes extensive written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: A score of 167 or better on the Spanish placement exam is required for matriculation in this course
Typically offered in Fall and Spring

FLS 201 Intermediate Spanish I (3 credit hours)
Continued development of communicative abilities for students with previous study of elementary level Spanish. Integrated skills approach (speaking, listening, reading, writing). Students will learn to function in everyday situations, expressing opinions and doubts, and narrating and describing in present, past, and future time, and will explore cultural issues through literary and other types of readings. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 102,105 or 110
Typically offered in Fall, Spring, and Summer

FLS 202 Intermediate Spanish II (3 credit hours)
Development of communicative abilities at the intermediate level of the American Council on the Teaching of Foreign Language proficiency scale, with an integrated skills approach (reading, writing, speaking, listening) and additional emphasis on knowledge and competence in the cultures of the Spanish-speaking world. Includes written and oral assignments of language structures and vocabulary. Conducted entirely in Spanish. Closed to native speakers of Spanish.

Prerequisite: FLS 201 or FLS 212
GEP Global Knowledge
Typically offered in Fall, Spring, and Summer

FLS 212 Spanish: Language, Technology, Culture (3 credit hours)
A study of the language structures and vocabulary necessary for an intermediate level of communication in Spanish together with cultural and technical issues of our global society in the context of the Spanish-speaking world. Fulfills the FLS 201 requirement.

Prerequisite: FLS 102 or FLS 110 or FLS 105
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

FLS 295 Intermediate Special Topics in Spanish (3 credit hours)
Special Topics in language and cultures of the Spanish speaking world for students at the intermediate (200) level. Includes courses taught in Spanish study abroad programs. Course may be taken up to three times.

Prerequisite: FLS 201
Typically offered in Fall, Spring, and Summer

FLS 331 Spanish Oral and Written Expression I (3 credit hours)
Development of speaking and writing skills at the Intermediate Mid to Intermediate High levels of the American Council on the Teaching of Foreign Languages proficiency scale, as well as listening/viewing and reading skills. Focus on sentence and paragraph-length discourse, narration and description in present, past, and future time frames within a variety of topics and contexts, and communication skills such as circumlocution. Course readings, video and discussion content center upon culturalaspects of the Spanish speaking world.

Prerequisite: FLS 202
Typically offered in Fall, Spring, and Summer

FLS 332 Spanish Oral and Written Expression II (3 credit hours)
Development of speaking and writing skills at the Intermediate High levels of the American Council on the Teaching of Foreign Languages proficiency scale, as well as listening/viewing and reading skills. Focus on paragraph-length discourse, narration and detailed description in present, past, and future time frames within a variety of topics and contexts, and communication skills such as circumlocution. Course readings, video and discussion content center upon cultural aspects of the Spanish speaking world.

Prerequisite: FLS 202
Typically offered in Fall and Spring

FLS 333 The Sounds of Spanish (3 credit hours)
A study of the pronunciation and phonological system of Spanish, with the goals of improving student pronunciation and analyzing native Spanish pronunciation. Extensive practice in phonetic transcription and pronunciation, as well as phonetic/phonological dialect variation.

Prerequisite: FLS 202
Typically offered in Fall and Spring

FLS 335 Spanish for Native and Heritage Speakers (3 credit hours)
This course is designed to meet the needs of native and heritage speakers of Spanish whose linguistic level is above that of our 200-level courses. Development of oral and writing skills at the Advanced-Mid through Superior levels of the American Council on the Teaching of Foreign Languages proficiency scale.

R: Native or heritage speaker of Spanish
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLS 336 Spanish for Business (3 credit hours)
Business Spanish vocabulary and terminology. Emphasis on everyday spoken and written Spanish. Readings and discussions of business topics. Cross-cultural considerations relative to international business operations.

P: FLS 331 or FLS 335
Typically offered in Fall only

FLS 337 Spanish for Tourism in the Hispanic World (3 credit hours)
Exploration of the tourism industry in the Spanish speaking world from cultural-historical, geographic, and linguistic perspectives. Course can lead to Tourism Certificate in Spanish from the Chamber of Commerce and Industry of Spain.

Prerequisite: FLS 202

FLS 340 Introduction to Hispanic Literatures and Cultures (3 credit hours)
Exploration of what literature is; what it means to read literature; and why one might be interested in analyzing literature. Introduction to literary terminology, as well as literary genres and movements in the Spanish language. Examination of social-cultural-historical contexts of Spain and Latin America, particularly matters of race, class, gender, and political ideas as they relate to literatures of the Spanish speaking world. Interpretation and analysis of literary texts, cultural institutions, and objects of national, mass, and popular cultures.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FLS 341 Literature and Culture of Spain I (3 credit hours)
Survey of literary and cultural contexts of medieval and early modern Spain (12th to 17th centuries). Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLS 342 Literature and Culture of Spain II (3 credit hours)
Survey of literary and cultural contexts of 18th and 19th century Spain. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLS 343 Literature and Culture of Spain III (3 credit hours)
Survey of literary and cultural contexts of 20th and 21st century Spain. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Spanish society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FLS 351 Literature and Culture of Latin America I (3 credit hours)
Survey of literary and cultural contexts of Latin America from the pre-conquest, colonial and early-independence periods (15th to mid 19th centuries). Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLS 352 Literature and Culture of Latin America II (3 credit hours)
Survey of literary and cultural contexts of Latin America from the Mid 19th to the Mid 20th centuries. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLS 353 Literature and Culture of Latin America III (3 credit hours)
Survey of literary and cultural contexts of Latin America since 1960. Examination of literary genres in connection with concurrent cultural and historical events. Exploration of literature as a reflection of the experiences and events meaningful to Latin American society during this time period. Emphasis on the ways in which literature and other cultural artifacts give voice to value systems, traditions, and beliefs.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FLS 360 Hispanic Cinema (3 credit hours)
Survey of the major contributions of Hispanic cinema from its origins to the present. Analysis of film as an artistic medium and as the cinematic representation of Hispanic histories and cultures. Reading, discussions, and viewing of films by representative directors.

Prerequisite: FLS 331 or FLS 332 or FLS 335
GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Spring only

FLS 395 Study Abroad Programs in Spanish (3 credit hours)
Specific category of courses in Spanish involving language and/or culture taught in Spanish-speaking countries through the Department Study Abroad Program.

Prerequisite: FLS 202
Typically offered in Fall, Spring, and Summer

FLS 399 Intensive Spanish Oral Proficiency Workshop (1 credit hours)
Extensive conversation centered upon the communicative functions of the intermediate high to advanced levels of the American Council on the Teaching of Foreign Languages (ACTFL) Oral Proficiency Scale. Assignments will include listening/viewing and speaking tasks to support in class activities. Designed to help Spanish majors to achieve the intermediate high oral proficiency level required for graduation. This is a 5-week course. Departmental permission is required.

Prerequisite: 3 Hours of 300-level Spanish
Typically offered in Fall, Spring, and Summer

FLS 400 Methods and Techniques in Spanish Translation and Interpretation (3 credit hours)
Study and practical application of theory, methods and techniques of translation based on materials relevant to various fields and professions.

Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Spring only

FLS 401 Spanish Graduate Reading (3 credit hours)
Basic Spanish grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in students' areas of research. Prepares students to take the graduate foreign language certification exam.

Typically offered in Fall only

FLS 402 Introduction to Spanish Linguistics (3 credit hours)
Introduction to fundamental terminology and concepts in the study of linguistics. Overview of the Spanish phonetics and phonology, morphology, syntax, semantics, pragmatics, sociolinguistics and historical linguistics.

Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Fall only

FLS 405 Spanish-English Comparative Grammar (3 credit hours)
Analysis of the linguistic and grammatical structure (phonology, morphology, syntax, and discourse) of English and Spanish in order to develop a deeper understanding of how both linguistic systems function in similar and different ways.

Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Spring only

FLS 411 Topics in the Culture of Spain (3 credit hours)
Exploration of particular themes related to the culture of Spain, with culture broadly defined as history, social and political aspects of society, as well as human and artistic expression including use of language, literary production, performance,print, and electronic media. Themes in this course expand upon those introduced in the 300 level of the Spanish curriculum. Class discussion and assignments require greater depth and sophistication than introduction to literature and culture courses of the 300 level.

Prerequisite: 12 credits of 300-level Spanish
Typically offered in Fall and Spring

FLS 412 Topics in the Culture of Latin America and the Caribbean (3 credit hours)
Exploration of particular themes related to the culture of Latin America and the Caribbean, with culture broadly defined as history, social and political aspects of society, as well as human and artistic expression including use of language, literary production, performance, print, and electronic media. Themes in this course expand upon those introduced in the 300 level of the Spanish curriculum. Class discussion and assignments require greater depth and sophistication than introduction to literature and culture courses of the 300 level.

Prerequisite: 12 credits of 300-level Spanish

FLS 413 Spain and the Americas in Transatlantic Perspective (3 credit hours)
Exploration of key moments of communication, exchange and conflict between the different parts of the Spanish speaking world, from the point of contact between imperial Spain and the indigenous civilizations of the "New World". Examination of the commonalities and distinctions of the quest for independence, modernity and democracy. Analysis of immigration across national frontiers in the present day Hispanic World and greater American continent.

Prerequisite: 12 credits of 300-level Spanish

FLS 445/FLS 545 Spanish Environmental Cultural Studies (3 credit hours)
This seminar will serve as an exploration of environmental cultural studies in contemporary Spain. It will examine questions such as climate change, industrial agriculture, animal rights, sustainability, environmental justice, eco-feminism and others in the context of contemporary Spanish culture. The course will also serve as an introduction to environmental activism and environmental politics in Spain and at the planetary level. It will make use of theoretical and critical readings, films, literary works, and other cultural products. Students cannot receive credit for both FLS 445 and FLS 545.

P: 12 hours of 300-level Spanish
Typically offered in Fall and Spring

FLS 492/FLS 592 Seminar in Hispanic Studies (3 credit hours)
Advanced seminar on a specific area of Hispanic studies (topics vary), leading to a major term paper and/or a series of essays by the student.

Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Spring only

FLS 495 Advanced Study Abroad Programs in Spanish (3 credit hours)
Specific category of courses in Spanish at the 400-level involving language and/or culture taught in Spanish-speaking countries through the Department Study Abroad Program.

Prerequisite: 12 credits of 300-level Spanish
Typically offered in Fall, Spring, and Summer

FLS 502 Linguistic Structure of Spanish (3 credit hours)
Introduction to fundamental terminology and concepts in the study of linguistics. Overview of the Spanish sound system (phonology), principles of word formation such as derivation and inflection (morphology), structure and grammatical relations of phrases and sentences (syntax), as well as the relationship between linguistic levels. Graduate standing required.

Typically offered in Fall only

FLS 503 Spanish Applied Linguistics (3 credit hours)
Overview of prominent theoretical perspectives in the acquisition of Spanish as a second language. Application of theory to the learning and teaching of the Spanish language. Analysis of issues in the acquisition of Spanish phonology, morphosyntax, semantics, and pragmatics. Graduate standing required.

Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Spring only

FLS 504 Spanish Language Change and Variation (3 credit hours)
Overview of phonological and morphosyntactic change from Latin to modern Spanish. Linguistic exploration of social and geographical dimensions Spanish language variation. Examination of issues of Spanish/English contact in the United States, including bilingualism and bilingual education. Graduate standing required.

Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Fall only

FLS 509 Spanish Phonetics and Phonology (3 credit hours)
A theoretical introduction to the phonetics and phonological system of Spanish. Topics covered include articulatory phonetics, narrow and broad transcription, and the analysis of linguistic data with the goal of understanding the underlying system of Spanish sounds. Current topics in Spanish phonology are included. Graduate standing required.

Prerequisite: FLS 502 (Linguistic Structure of Spanish)
Typically offered in Fall, Spring, and Summer

FLS 512 Spanish in the United States (3 credit hours)
A study of the varieties of Spanish spoken in the United States from the linguistic perspective. The course examines the historical and socio-political motives for distinct waves of immigration as a means to understand the development of unique dialects and sociolects that are emerging across the country. Readings and lectures explore topics such as phonetic, morphosyntactic, geographic, and social variation; bilingualism and language contact; language acquisition and education; and language in the media and public space.

Prerequisite: FLS 502 or Permission of Instructor
Typically offered in Spring only

FLS 515 History of Spanish Language (3 credit hours)
Overview of historical evolution of modern Spanish from spoken Latin. Focus on theories of language change as applied to the historical development of Spanish. Graduate status or instructor permission required.

Prerequisite: FLS 502 or equivalent; or permission of instructor
Typically offered in Spring only

FLS 520 Survey of Hispanic Literature and Culture (3 credit hours)
This course covers literature from the 8th century on in the Peninsular context and/or from the times of the pre-Conquest in Latin America to the present. It focuses on short stories, poetry, essays and films as well as different critical and theoretical analyses of culture. Its purpose is to familiarize graduate students with Latin American and/or Peninsular literature and culture and to provide a foundation for the other course offerings in literature/culture in the graduate program. It can be taught as a survey of Peninsular or Latin American literature or both.

Prerequisite: Graduate standing
Typically offered in Fall only

FLS 528 Don Quixote (3 credit hours)
This course studies the historical and political contexts of Cervante's writing, his place in Renaissance culture, and the role of Don Quixote in the formation of the modern novel. Taught in Spanish. Graduate status or permission of the instructor.

Typically offered in Fall only

FLS 530 The Cultural Production of Spanish Democracy (3 credit hours)
Challenges, contradictions, accomplishments, and shortcomings in the political, social, economic, cultural, and literary dimensions of Spain in the last quarter of the 20th century. Treatment of literary texts, historical and journalistic documents, critical and theoretical essays, as well as fiction and non-fiction films, music, and other products of popular and mass culture since 1975. Particular attention to significant cultural events such as the 1992 Barcelona Olympics, and the celebration of the 500th anniversary of the "Discovery" of America. Must hold graduate standing.

Typically offered in Fall only

FLS 545/FLS 445 Spanish Environmental Cultural Studies (3 credit hours)
This seminar will serve as an exploration of environmental cultural studies in contemporary Spain. It will examine questions such as climate change, industrial agriculture, animal rights, sustainability, environmental justice, eco-feminism and others in the context of contemporary Spanish culture. The course will also serve as an introduction to environmental activism and environmental politics in Spain and at the planetary level. It will make use of theoretical and critical readings, films, literary works, and other cultural products. Students cannot receive credit for both FLS 445 and FLS 545.

P: 12 hours of 300-level Spanish
Typically offered in Fall and Spring

FLS 550 Latin America, Inc: Legacies of Extraction Economies and Resource Exploitation in Art and Literature (3 credit hours)
From the diaries of Christopher Columbus to the implementation and maturation of NAFTA-era trade policies, the area of Latin America has consistently been perceived as a type of raw material available for the extraction, production and enrichment of individuals, nations and multinational corporations that are based outside of the region's boundaries and hold positions of economic hegemony. Beginning with the colonial-era European production and consumption of tobacco, chocolate and precious metals and moving through 19th-century industrialization, world's fairs, 20th-century food, drink and film industries and the impact of late 20th-century neoliberal trade policies and tourism, we will explore the impact of external economic exploitation in Latin American contexts through a variety of texts, films, historic and contemporary publicity campaigns and cultural representations.

P: FLS 520
Typically offered in Spring only

FLS 553 The Latin American Avant-Garde (3 credit hours)
An in-depth analysis of the cultural avant-garde in Latin America at the beginning of the twentieth century (1905-1939). Students will study European and Latin American theories of the avant-garde, literature, art, music, and manifestation from the period in several Latin American countries. Graduate standing required. Taught in Spanish.

Typically offered in Spring only

FLS 554 The Sixties in Latin America (3 credit hours)
An in-depth analysis of the cultural production during the 60s in Latin America. Students will study novels, short stories, poetry, music, and film from several Latin American countries. Graduate standing required.

Typically offered in Fall only

FLS 563 The Latin American Novel (3 credit hours)
The course offers a comprehensive view of Latin America novel (from the 19th Century until the present). It centers its attention foremost on canonical works (Isaacs, Gallegos, Vargas Llosa, Puig, etc.). Besides familiarizing students with the political, social and cultural contexts that gave rise to these texts, it also provides, through the reading of various theoretical articles, a basic introduction to narrative theory (Genette, Booth, Bal, Brooks, etc.). Graduate standing required.

Typically offered in Spring only

FLS 592/FLS 492 Seminar in Hispanic Studies (3 credit hours)
Advanced seminar on a specific area of Hispanic studies (topics vary), leading to a major term paper and/or a series of essays by the student.

Prerequisite: 12 credits of 300 level Spanish or higher
Typically offered in Spring only

FLS 595 Special Topics in Spanish (1-3 credit hours)
In depth exploration of specialized topics in Spanish literature, culture or language. Also used to test and develop new courses.Course taught in Spanish.

Prerequisite: Graduate Standing or Permission of the Instructor
Typically offered in Fall and Spring

FLS 630 Independent Study in Spanish (1-3 credit hours)
Individualized study in Spanish language or literature at the graduate level. Topic and mode of study to be determined in consultation with the faculty member supervising work.

Typically offered in Fall only

FLS 675 Special Project in Spanish (1-3 credit hours)
Individual project in Spanish language or literature at the graduate level. Topic and mode of study to be determined in consultation with student's project advisory committee within the parameters of specific options.

Prerequisite: Student must be in final semester of his or her program
Typically offered in Fall and Spring

FLS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

Foreign Language-Classical Studies (CLA)

CLA 110 Greek and Latin Roots of English (3 credit hours)
Study of the formation of English words from Greek and Latin roots, designed to build English vocabulary and word power (Students who plan to enter medical professions should take CLA 115. Students may not receive credit for both CLA 110 and CLA 115.)

Typically offered in Spring only

CLA 115 Medical Terminology (3 credit hours)
Study of the formation of medical terms from their Greek and Latin roots designed both to build vocabulary and to teach the uses of a medical dictionary. Students may not receive credit for both CLA 110 and CLA 115.

Typically offered in Fall and Spring

CLA 210 Classical Mythology (3 credit hours)
Greek and Roman mythology through the writings and art of the Classical period. Discussion of creation stories, the major gods and heroes, the underworld and afterlife, intellectual, religious and educational role of myth, and the most important theories of interpretation and classification. All readings and discussion in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Summer

CLA 215 The Ancient World in Modern Media (3 credit hours)
Study of the ways classical myth and culture appear in modern media such as film, TV, comics, the internet and others, with focus on why ancient stories, ideas and images are still appealing, but also how and hwy they are used in new ways with new meanings.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

CLA 320 Masterpieces of Classical Lit (3 credit hours)
Study of great works of Greek and Latin Literature in a genre such as tragedy, comedy, epic or lyric, with attention to both literary merit and cultural importance. All readings in English. May be taken up to three times in different genres for credit.

R: Sophomore Standing
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

CLA 325 Gender, Ethnicity & Identity in the Ancient World (3 credit hours)
Study of the formation of ideas and practices regarding gender, ethnicity, and identity in the ancient Greek and Roman world, with attention to both continuities and difference between ancient and modern views

R: Sophomore Standing
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

CLA 395 Special Topics in Classical Studies (3 credit hours)
For topics not part of regular course offerings, or offering of new courses on a trial basis. May be taken up to three times provided the topics are different.

CLA 398 Independent Study in Classical Studies (1-3 credit hours)
Individualized study in classical language, culture or literature. Topic, mode of study, and credit hours to be determined in consultation with faculty member supervising work. May be taken up to three times provided the topic is sufficiently different. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

R: Sophomore Standing

Foreign Languages (FL)

FL 210 Global Literature and Culture (3 credit hours)
This course examines urban society, popular culture, and social change in the twentieth century in different regional contexts - East Asia, Latin America, the Middle East, South Asia, Western Europe, and Francophone or other colonial contexts. The regional focus of the course varies as the teaching team varies. The course is divided into segments which may include: Language and the Print Revolution; War and Colonization; Society and Gender Issues; Popular Culture and the Arts; and Cultural Expression in the Age of Global Capital. Content will include lectures and primary and secondary materials from multiple regional contexts.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 211 Introduction to the French-speaking World (3 credit hours)
An introduction to the diverse nature of the French-speaking world and its relationship to the United States. By examining various types of media from literature to film, we will trace the roots of Franco-American relationships from Imperialism to the present day. Topics include historical and current perspectives from Acadia, Haiti and the Antilles, North and West Africa and Europe. It will emphasize questions of identity, migration, creolite, negritude, social justice and current events.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 216 Art and Society in France (3 credit hours)
An overview of the visual arts in France, defined broadly, and their relationship to French society and culture: painting, architecture, photography, cinema, book production, gardens, fashion, food, television, popular culture, and mass media, including the Internet. The principal themes of the course are how France's cultural heritage is embodied in its rich tradition of visual expression and how artists' visual expressions have either served to represent, glorify, or critique the nation.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

FL 219/ENG 219 Studies in Great Works of Non-Western Literature (3 credit hours)
Readings, in English translation, or non-Western literary masterpieces from the beginnings of literacy in the Middle East, Asia, and Africa to the modern period, including excerpts from texts such as the Upanishads, the Ramayana, the Sundiata, Gilgamesh, A Thousand and One Nights, and the Quran and such authors as Confucius, Oe Kenzaburo, Omar Khayyam, Rumi, and Amos Oz.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 220/ENG 220 Studies in Great Works of Western Literature (3 credit hours)
Readings, in English translation, of Western literary masterpieces, from the beginnings of literacy in the Middle East and Europe towards the present, including such authors as Homer, Sophocles, Virgil, Ovid, Augustine, Dante, Machiavelli, Shakespeare, Cervantes, Moliere, Voltaire, Goethe, Austen, Flaubert, Dickinson, Tolstoy, Kafka, and Woolf. Credit will not be given for both ENG/FL 220 and either ENG/FL 221 or ENG/FL 222.

Restricton: Credit is not allowed for both ENG 220 and ENG 221 or ENG 222.
GEP Global Knowledge, GEP Humanities
Typically offered in Summer only

FL 221/ENG 221 Literature of the Western World I (3 credit hours)
Readings from English translations of Biblical, Classical, Medieval, and Early Renaissance literature, including works by such authors as Homer, Plato, Virgil, Ovid, St. Paul, St. Augustine, Marie de France, and Dante. Credit is not allowed for both ENG 221 and ENG 220.

Restriction: Credit is not allowed for both ENG 221 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FL 222/ENG 222 Literature of the Western World II (3 credit hours)
Readings from English translations of Renaissance, Neo-Classical, Romantic, and Early Modern literature, emphasizing the cultures of continental Europe from the Renaissance to 1900, and including such authors as Petrarch, Erasmus, Rabelais, Machiavelli, Shakespeare, Moliere, Voltaire, Rousseau, Goethe, Flaubert, and Tolstoy. Credit is not allowed for both ENG 220 and ENG 222.

Restriction: Credit is not allowed for both ENG 222 and ENG 220.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 223/ENG 223 Contemporary World Literature I (3 credit hours)
Twentieth-century literature of some of the following cultures: Russian, Eastern European, Western European, Latin American, Canadian, Australian.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 224/ENG 224 Contemporary World Literature II (3 credit hours)
Twentieth-century literature of some of the following cultures: Asian, Middle Eastern, African, Caribbean, Native-American.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

FL 246/ENG 246 Literature of the Holocaust (3 credit hours)
Fictional and nonfictional versions of the Holocaust, focusing on themes of survival, justice, theology, and the limits of human endurance.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 250 Austrian Culture Up Close (3 credit hours)
This course provides students with direct experiences of Austrian culture while studying in Vienna, Austria's capital city. Readings in Austrian history, literature, music, psychology, and the visual arts, supplemented by numerous museum tours, concerts, and travel in Austria and central Europe. Students will examine and evaluate Austrian culture, society, and history through a variety of primary-source cultural artifacts (e.g. visual art, literature, architecture, music, and scientific literature) as well as secondary sources (e.g. articles and interpretive essays). Taught in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Summer only

FL 275/ENG 275 Literature and War (3 credit hours)
A geographical and thematic examination of war and questions it raises, as reflected in selected writings from, Homer, Sophocles, Japan's Tale of the Heike, Shakespeare, The Bhagavad-Gita, Keegan, Kipling, Graham Green, Mulden, Michael Herr, Dexter Filkins, Lucius Shepherd as well as writers on Just War and Deterrence Theory, and military science.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 295 Special Topics in Foreign Languages and/or Literatures (1-6 credit hours)
A special projects course on topics to be determined as needed in the departmental program.

Typically offered in Fall, Spring, and Summer

FL 298 Independent Study in Foreign Language or Literature (1-6 credit hours)
Individualized study in a foreign language or literature. Topic, mode of study and credit hours to be determined in consultation with the faculty member supervising work. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FL 299/ED 299 Field Experience for 21st Century Teaching (1 credit hours)
This course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge. This course is restricted to Foreign Language Education majors.

Prerequisite: ECI 204 and ED 204
Typically offered in Spring only

FL 392/ENG 392 Major World Author (3 credit hours)
Intensive study in English, of the writings of one (or two) author(s) from outside the English and American traditions. Sample subjects: Homer, Virgil and Ovid, Lady Murasaki, Marie de France and Christine de Pizan, Dante, Cervantes, Goethe, Balzacand Flaubert, Kafka, Proust, Lessing and Gordimer, Borges and Marquez, Neruda, Achebe, Soyinka, Calvino, Walcott and Naipaul. Topics will vary from semester to semester. May be repeated for credit with new topic.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 393/ENG 393 Studies in Literary Genre (3 credit hours)
Concentrated treatment of one literary genre, such as the epic, the lyric, the drama, satire, romance, autobiography, the essay, the novel, or the short story. Treatment of materials from several national or ethnic cultures and several periods. All readings in English. Course may be taken three times for credit. Course may be taken 3 times in different genres.

Prerequisite: Sophomore standing and above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 394/ENG 394 Studies in World Literature (3 credit hours)
Study of a subject in world literature: for example, African literature, Asian literature, Hispanic literature, East European literature, Comedy, the Epic, the Lyric, Autobiography, the Faust legend, or Metamorphosis. Subjects vary according to availability of faculty. Readings in English translation.

Restriction: Sophomore Standing and Above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

FL 395 Study Abroad Programs (1-3 credit hours)
Specific category of courses involving language and/or culture taught in foreign countries through the Department Study Abroad Program.

FL 406/ENG 406 Modernism (3 credit hours)
Review and discuss the International Modernist movement in literature, from its nineteenth-century origins to its culmination in the early twentieth century. Identify and discuss definitions of modernity, as embodied in a variety of genres. Discuss Modernist texts within a variety of cultures that produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FL 407/ENG 407 Postmodernism (3 credit hours)
Study literary expressions of postmodernism, from its origins in the Modernist movement through its culmination in the later decades of the twentieth century and after. Examine post modernity, as embodied in a variety of genres. Situate postmodernist texts within a variety of cultures that have produced them.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FL 424/FL 524 Linguistics for ESL Professionals (3 credit hours)
Study of the diachronic nature of language and the phonological, morphological, syntactic, and semantic features of English in relation to other world language groups. Application of linguistic principles to the ESL classroom. Analysis of common errors in grammar due to first language interference. Discussion of teaching strategies based on current research in second-language acquisition. Credit will not be given for both FL 424 and FL 524.

Typically offered in Spring only

FL 427/ECI 427/ECI 527/FL 527 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.

Typically offered in Fall and Spring

FL 436/ECI 436/FL 536/ECI 536 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.

GEP U.S. Diversity
Typically offered in Fall and Spring

FL 440 Internship in Teaching English as a New Language (3 credit hours)
Capstone course in which candidates practice and further develop the knowledge, skills, and dispositions necessary for teaching English language learners through a set of clinical field experiences in a K-12 classroom.

Prerequisites: FL 436 and FL 424 and FL 427. After the completion of two prerequisites, FL 440 may be taken concurrently with the third prerequisite, pending instructor approval.
Typically offered in Fall and Spring

FL 441 Strategies and Curriculum Design in Teaching English as a Foreign Language (TEFL) (3 credit hours)
This course provides an overview of three main aspects of teaching English as a Foreign Language: planning, instructing, and assessing. Students will examine the most common types of curricula and practice syllabus design, lesson planning, and assessments. They will explore the characteristics of different types of learners (e.g., young learners, post-secondary adults, immigrants, etc.) and their motivation for learning English. Students will practice a variety of communicative, collaborative activities for all levels and contexts.

P: FL 427 (Methods and Materials in Teaching ESL)
Typically offered in Spring only

FL 492 Senior Seminar in Foreign Languages & Literatures (3 credit hours)
Senior seminar for foreign language majors with concentration in non-European / less-commonly taught languages. Focus on recent trends in scholarship, career guidance, senior research projects or equivalent. Conducted in English. Students will be required to provide a detailed summary of their project in the language of their concentration.

Prerequisite: FLJ 301 or FLC 301 or FLN 301 or FLA 301
Typically offered in Spring only

FL 495/FL 595 Special Topics in Foreign Languages and Literatures (1-6 credit hours)
A concentrated study of a special period, author or genre to be determined as needed in the departmental program.

FL 498 Independent Study in Foreign Language or Literature (1-6 credit hours)
Individualized study of a foreign language or literature. Topic, mode of study, and credit hours to be determined in consultation with the faculty member supervising work. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FL 505/ECI 505 Issues and Trends in Foreign Language Education: Theory & Practice (3 credit hours)
An exploration of theory and practice issues related to foreign language teaching. Inquiry into proficiency-oriented instruction, innovative methodological approaches, the National Standards and learning scenarios, integrating culture, options for testing and assessment, content-based instruction, the role of grammar in second language acquisition, teaching foreign language students with learning disabilities, and Foreign Language in the Elementary School (FLES) in North Carolina. Students will examine case studies related to these topics and engage in a classroom action research project.

Prerequisite: Graduate standing
Typically offered in Fall and Summer

FL 506 Instructional Technology in Foreign Language Education: Addressing the Standards (3 credit hours)
Hands-on experience in appropriately selecting and applying a number of instructional technologies to foreign language teaching and learning in relation to the current National Standards. Analysis and use of effective technology tools including hardware, software, and courseware. Emphasis will be on the application of Technology-Enhanced Language Learning (TELL) as it integrates the National Standards' goals of Communication, Cultures, Connections, Comparisons, and Communities.

Restriction: Graduate standing; NC Initial/A licensure in French, Spanish or ESL
Typically offered in Summer only

FL 507 College Teaching of Foreign Languages (3 credit hours)
Principles of second language acquisition and foreign language pedagogy. Examination of problematic concepts in teaching Spanish and French. Thorough treatment of instructional technology appropriate to foreign language teaching and learning. Regular observation of practicing instructors and micro-teaching in college-level Spanish or French classes. Credit not given for both FL 507 and either FL/ECI 505 or FL/ECI 506. Course taught in English. Required for new FLL Teaching Assistants.

Prerequisite: Graduate status
Typically offered in Fall only

FL 508 Second Language Acquisition Research: Interlanguage Development (3 credit hours)
This course introduces students to the objectives, methods, and findings of research investigating how classroom learners acquire French and Spanish as a second language. It examines specific features of French and Spanish interlanguage including: grammatical gender, copular ser/estar and idiomatic uses of etre/avoir, pronominalization, verbal systems, and longitudinal/cross-sections studies of interlanguage development. Course content bridges the gap between second language acquisition research, foreign language teaching methodology courses, and curriculum implementation. Graduate standing or consent of instructor required.

Prerequisite: Graduate Standing or Permission of the Instructor
Typically offered in Spring only

FL 524/FL 424 Linguistics for ESL Professionals (3 credit hours)
Study of the diachronic nature of language and the phonological, morphological, syntactic, and semantic features of English in relation to other world language groups. Application of linguistic principles to the ESL classroom. Analysis of common errors in grammar due to first language interference. Discussion of teaching strategies based on current research in second-language acquisition. Credit will not be given for both FL 424 and FL 524.

Typically offered in Spring only

FL 527/FL 427/ECI 427/ECI 527 Methods and Materials in Teaching English as a Second Language (3 credit hours)
Methodologies and current approaches to teaching English as a Second Language. Techniques and strategies for teaching reading, writing, listening, speaking and culture. Selection, adaptation, and creation of instructional materials for various levels of proficiency and teaching situations. Evaluation and assessment of written and oral language proficiency through standardized and non-standardized assessment tools. Students cannot receive credit for both FL/ECI 427 and FL/ECI 527.

Typically offered in Fall and Spring

FL 535 Teaching Academic Writing to Multilingual Learners (3 credit hours)
Students will explore current theory and research in second language writing. Topics include intercultural rhetoric, second language writing curriculum, first language grammar interference, and the development of academic vocabulary. Students will learn innovative teaching strategies and activities that help multilingual writers practice writing across genres and disciplines.

Restriction: Graduate Standing
Typically offered in Fall only

FL 536/ECI 536/FL 436/ECI 436 Perspectives on English as a New Language (3 credit hours)
Examination of the complexity of multiculturalism in American society and the challenges faced by immigrant families in adapting to U.S. institutions. Emphasis on understanding historical, legal, cultural and pedagogical issues with respect to learning English as a new language [ENL]. No credit given for both FL/ECI 436 and FL/ECI 536.

GEP U.S. Diversity
Typically offered in Fall and Spring

FL 539/ENG 539 Seminar In World Literature (3 credit hours)
Rotating topics in world literature, including treatment of the subject's theoretical or methodological framework. Possible subjects: colonialism and literature; orality and literature; the Renaissance; the Enlightenment; translation; comparison ofNorth and South American literatures; African literary traditions; post-modernism and gender. Readings in English (original languages encouraged but not required).

Typically offered in Spring only

FL 595/FL 495 Special Topics in Foreign Languages and Literatures (1-6 credit hours)
A concentrated study of a special period, author or genre to be determined as needed in the departmental program.

FL 675 Special Project in TESOL (3 credit hours)
Detailed investigation to research, write, and present a research project of selected topics in Teaching English to Speakers of Other Languages (TESOL). Topic and mode of study to be determined in consultation with student's project advisory committee.

Typically offered in Fall, Spring, and Summer

Foreign Languages and Literatures - Arabic (FLA)

FLA 101 Beginning Arabic 101 (3 credit hours)
Beginning Arabic is for students who have had no prior experience with the language. It is the first in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. Authentic materials from the Arabic media will be used in addition to text-related video and audio materials. An introduction to Arab culture will be integrated throughout the semester.This course is designed for true beginners who have had no previous experience with the Arabic language, either written or spoken. Credit will be allowed for either FLA 101 or FLA 111, but nor for both.

Typically offered in Fall and Summer

FLA 102 Beginning Arabic 102 (3 credit hours)
This course is the second in a series which develops reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. Authentic materials from the Arabic media will be used in addition to text-related video and audio materials. An introduction to Arab culture will be integrated throughout the semester.Credit will be allowed for either FLA 102 or FLA 112, but not for both.

Prerequisite: FLA 101 or 111
Typically offered in Spring and Summer

FLA 103 Beginning Arabic 101 Conversation (1 credit hours)
Supplements conversational practice for FLA 101 to help students develop oral proficiency at the beginning level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations

Corequisite: FLA 101
Typically offered in Fall and Summer

FLA 104 Beginning Arabic 102 Conversation (1 credit hours)
Supplements conversational practice for FLA 102 to help students develop oral proficiency at the advanced beginning level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in basic social situations.

Corequisite: FLA 102
Typically offered in Spring and Summer

FLA 201 Intermediate Arabic I (3 credit hours)
Intermediate Arabic I is the third in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. An increased emphasis is placed onthe acquisition of vocabulary and grammatical tools necessary to undertake more in-depth readings and discussions of news articles from the Arab media. Authentic materials from the Arab media will be used in addition to text-related video and audio materials.

Prerequisite: FLA 102 or FLA 112
Typically offered in Fall only

FLA 202 Intermediate Arabic II (3 credit hours)
Intermediate Arabic II is the fourth in a series of courses which develop reading and writing skills in Modern Standard Arabic with active speaking and listening skills in both formal Arabic and the Egyptian dialect. A continued emphasis is placed on the acquisition of vocabulary and grammatical tools necessary to undertake more in-depth readings and discussions of news articles from the Arab media. Authentic materials from the Arab media will be used in addition to text-related video and audiomaterials.

Prerequisite: FLA 201
Typically offered in Spring only

FLA 203 Intermediate Arabic Conversation I (1 credit hours)
Supplements conversational practice for FLA level 201 or higher. This course helps students develop oral proficiency at the intermediate level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in various social situations.

Prerequisite: FLA 102
Typically offered in Fall only

FLA 204 Intermediate Arabic Conversation II (1 credit hours)
Supplements conversational practice for FLA level 202 or higher. This course helps students develop oral proficiency at the intermediate high level. Students will practice using their speaking skills in a variety of individual and group activities to build competency in various social situations.

Prerequisite: FLA 201
Typically offered in Spring only

FLA 301 Advanced Intermediate Arabic I (3 credit hours)
Advanced Intermediate Arabic I is the fifth in a series of courses which develop whole language skills in Modern Standard Arabic with active speaking and listening skills in the Egyptian dialect. Upon completion of this course the student will havethe tools necessary to understand and produce all the basic structures of Modern Standard Arabic. Arabic film and media will be used in class. The student will also be introduced to selected short stories from modern Arabic literature.

Typically offered in Fall only

FLA 318 Egyptian Culture through Film (3 credit hours)
This course offers a survey of cinema in modern Egypt using film as a medium to learn about the cultural and social structures in Egypt. The course incorporates weekly screenings of feature films representing different styles and periods. Students will be required to read relevant material, take essay exam questions, write film reviews, a final paper, and give a presentation of their final paper. The course is taught in English.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

FLA 330 Media Arabic (3 credit hours)
An introduction to the language of print and Internet news media of the Arab world, using authentic materials from Arabic newspapers, Internet news sites, and magazines. This course provides students with the tools necessary to build a core media vocabulary base, comprehend front page news stories, read critically, and detect bias, in selected news content, and develop listening skills necessary for understanding oral news reports.

Prerequisite:FLA 202
Typically offered in Spring only

FLA 351 Modern Arab Popular Culture (3 credit hours)
Introduction to basic aspects of cultural practices and production in diverse societies of the Arabic-speaking world in translation, including family relationships, education, work life, religious practices, gender and sexuality, language, and aesthetic traditions, including music, art, and film. Reading and analysis of representative works of modern Arab visual and print cultures including language, literature, film, digital media, music, and art with attention to cultural analysis as well as to historical and cultural background.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

FLA 440 Modern Arabic Short Story (3 credit hours)
An advanced language skills course which introduces students to contemporary Arabic literature through selected readings of modern Arabic short stories. Students will develop an understanding of this rich literary genre as a reflection of concurrent social structures, political landscapes, and cultural traditions in Middle Eastern societies. Emphasis will also be placed on recognizing advanced grammatical structures in Modern Standard Arabic with attention given to the increased use of vernacular expression in modern literary works. Assigned readings, writing assignments, and class discussions will be in Arabic.

Prerequisite: FLA 301 or FLA 330
Typically offered in Fall only

Forestry (FOR)

FOR 150 Critical Thinking and Data Analysis (2 credit hours)
Exploration and practical experience with basis for making resource management decisions. Learning to pose questions that drive research and analysis. Discovering differences between found and built answers. Examining spreadsheet structure and functionality for manipulating data. Establishing solid grounds for conclusions and actions in natural resources contexts. Experiencing thinking processes from posing questions to articulating well-founded answers in coherent, persuasive discourse.

Typically offered in Spring only

FOR 172 Forest System Mapping and Mensuration I (2 credit hours)
Concepts and application of basic forest and land resource measurement techniques used in forestry and related fields. Measuring distances and areas; orienteering; basic air photo and topographic map interpretation; introduction to GPS; measuring tree characteristics; introduction to forest sampling. Application of spreadsheets and word processing to analyze and summarize resource characteristics. Field trip required.

Typically offered in Fall only

FOR 204 Silviculture (2 credit hours)
Silvical characteristics and growth requirements of forest trees; dynamics of stand growth, species-site relationships, site productivity, forest pest interactions, hydrology and nutrient cycling in forest ecosystems; emphasis on understanding and applying ecological principles to the production of multiple benefits at the forest community level.

Typically offered in Summer only

FOR 248 Forest History, Technology and Society (3 credit hours)
Examining forest resource use and issues throughout history. Tracing developments and concepts that created the context for today's issues concerning global forest resources. Examining how wood resource availability shaped civilization's development, and examining consequences on forest resources of civilization's scientific, social, and technological progress.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

FOR 250 Professional Development II: Communications in Natural Resources (1 credit hours)
Development of written and oral communication skills for forestry and natural resources management. Discussion topics include interactive communication, writing to a target audience, common pitfalls in technical writing, various kinds of technical writing, poster and oral presentations, reviewing and revising writing, and responding to questions in a professional manner.

Typically offered in Spring only

FOR 252 Introduction to Forest Science (3 credit hours)
Integration of biological principles into studies of tree growth, reproduction, establishment, survival, and disturbance. Discussions of regional silviculture and of effects of humans on forest ecosystems. Instruction in forest sampling and tree identification. Many laboratories meet outdoors.Not open to Forest Management majors.

Not open to Forest Management Majors (15FOMND,15FORMTBS, 15FGM)
Typically offered in Spring only

FOR 260 Forest Ecology (4 credit hours)
Introduction to forest ecosystems, their structure and functions, and the processes that regulate them including: radiation, temperature, water, and biogeochemistry; productivity; plant populations; forest communities; succession; natural disturbances; and human influences. Must have a strong love of trees.

Typically offered in Spring only

FOR 261 Forest Communities (2 credit hours)
Study of the species composition, distribution, site requirements, and succession of the principal forest communities of southeastern North America. Identification of important member plant species. Field trips to typical examples.

Prerequisite: FOR 339 or PB 220 or PB 403
Typically offered in Summer only

FOR 264 Forest Wildlife (1 credit hours)
Diversity of fauna that inhabits forest communities in the Piedmont of North Carolina. Inventory terrestrial and aquatic habitats and identify various vertebrate and invertebrate species. Insect collection initiated. The life histories of representative species presented.

Typically offered in Summer only

FOR 265 Fire Management (1 credit hours)
Effects of wildfire and prescribed fire on forest ecosystem components and processes; fire behavior and the ecosystem and meterologic factors that affect it; silvicultural uses of fire; organization, equipment, and tactics for wildfire suppression; fire suppression exercises on the North Carolina Division of Forest Resources' Forest Fire Simulator.

Typically offered in Summer only

FOR 273 Forest System Mapping and Mensuration II (3 credit hours)
Procedures and Instruments for measuring various tree and stand characteristics. Determination of stem volume and taper. Planning and implementation of forest resource samples to provide population estimates using fixed-radius and variable-radius sampling. Detailed coverage of land measurements and mapping of boundary surveys. Use of aerial photography, topographic maps, and GPS to aid in resource assessment. Incorporation of inventory data into a GIS. Basic statistical concepts applied to resource measurements. Taught off-campus at Hill Forest.

Prerequisite: FOR 172
Typically offered in Summer only

FOR 293 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FOR 294 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FOR 295 Special Topics in Forestry (1-6 credit hours)
Study of forestry topics not covered in existing courses at the introductory level. Development of a new course on a trial basis.

Typically offered in Fall, Spring, and Summer

FOR 303 Silvics and Forest Tree Physiology (3 credit hours)
Ecological and physiological processes influencing establishment, growth, and development of forest stands with particular emphasis on forest types of Southeastern United States; influence of resource availability on forest stand productivity; physical and biochemical processes associated with tree function, including water relations, mineral nutrition, transport and translocation, photosynthesis, respiration; internal and environmental factors regulating tree growth and development.

P: (CH 101 or 103) and [(CH 201 and 202) or (CH 203 and 204) or PY 205 or PY 211]
Typically offered in Fall only

FOR 304 Theory of Silviculture (4 credit hours)
Ecological processes affecting the establishment and growth of forest stands with particular emphasis on forest types of the Southeastern United States. Forest stand productivity, how productivity is influenced by site, stand, climatic factors, and the application of site specific prescriptions to establish and manipulate the composition, growth, and health of forest stands.

Prerequisite: FOR 260 or PB 360 or AEC 360
Typically offered in Spring only

FOR 318/PP 318 Forest Pathology (3 credit hours)
Major diseases of forest trees and deterioration of wood products emphasizing principles of plant pathology; diagnosis; nature, physiology, ecology, and dissemination of disease-causing agents; mechanisms of pathogenesis; epidemiology and environmental influences; principles and practices of control.

Prerequisite: PB 200
Typically offered in Fall and Spring

FOR 319 Forest Economics (3 credit hours)
Economic approaches for evaluating the production and costs of forest management, timber harvesting activities, and nontimber forest products. Estimating the financial returns of long-term investments in timber or other forest resources, including discounted cash flow analysis and capital budgeting techniques. Property taxes and income tax treatment of timber and their effects on investment returns. Demand estimation and timber supply analyses.

Prerequisite: ARE 201 or EC 205 or EC 201
Typically offered in Fall only

FOR 330 North Carolina Forests (3 credit hours)
An introduction and overview of forests in North Carolina with emphasis on the importance of forests in the 21st century. Topics include: history and distribution of forests, soils-sit relationships, forestry practices, non-conventional management objectives. Two required Saturday field trips.

Typically offered in Fall only

FOR 334 Operations Research Applications in Natural Resources (1 credit hours)
Introduction to the application and use of management science in forestry and natural resources. The course will introduce decision and information theory and mathematical programming techniques including linear, non-linear and integer programming concepts. The emphasis is on problem formulation and solution using computer programs. Half semester course.

Typically offered in Spring only

FOR 339 Dendrology (4 credit hours)
Identification and elementary silvics of woody plants of eastern North America with studies of their classification, characteristics, and habitats. Consideration of trees from northern and western North America and the Caribbean region. Field identification with trips to forest communities.

Typically offered in Fall only

FOR 350 Professional Development III: Ethical Dilemmas in Natural Resource Management (1 credit hours)
Study of ethical issues confronting natural resource management professionals, including: biodiversity conservation, private property rights, traditional religion and ecological values, community rights, environmental racism, hunting and animal rights, business ethics, and the purpose and content of professional codes of ethics.

Prerequisite: Junior standing.
Typically offered in Spring only

FOR 353 GIS and Remote Sensing for Environmental Analysis and Assessment (3 credit hours)
This course provides a survey of topics targeting the processing and analysis of remotely sensed and other geospatial data collected in forestry, environmental, and natural resource inventory and analyses. Students develop a fundamental understanding of analysis techniques and data requirements that include aerial and photogrammetry applications, geostatistical and 3D image analyses, DEM and hydrologic modeling, image enhancement techniques, land cover classifications and accuracy assessment.

Restriction: Juniors & Seniors Only
Typically offered in Spring only

FOR 374 Forest Measurement, Modeling, and Inventory (3 credit hours)
Mathematical functions required for quantifying the yield of timber and non-timber products. Procedures for planning, conducting, and analyzing forest inventories. Use of mathematical models to estimate growth and yield of forest stands and non-timber products for management decisions.

Prerequisite: FOR 273
Typically offered in Fall only

FOR 402/ENT 402 Forest Entomology (3 credit hours)
Fundamentals of morphology, classification, biology, ecology and control of insects attacking trees, with emphasis on silvicultural practices.

Prerequisite: Junior standing.
GEP Natural Sciences
Typically offered in Spring only

FOR 405/FOR 505 Forest Management (4 credit hours)
Fundamental principles and analytical techniques necessary in the planning, management and optimization of forest operations. Formulation of objectives and constraints, yield forecasting, forest regulation, procurement and marketing, inventory methods, and management plan preparation. Written and oral reporting.

Prerequisite: FOR 304, FOR 319, FOR 374
Typically offered in Fall only

FOR 406 Forest Inventory, Analysis and Planning (4 credit hours)
Independent project in designing and implementing a multi-resource survey; analyze stand conditions; forecast growth, yield and revenue of timber and forest products; use linear programming to prepare a long-term management plan subject to economic,social, and ecological constraints; assess economic and environmental impacts of potential actions; and report results orally and in writing.

Prerequisite: FOR 405, FOR 460
Typically offered in Spring only

FOR 408/FOR 508 Hardwood Management (3 credit hours)
Examines characteristics of and requirements for successfully manipulating stands of deciduous trees to meet specific economic, habitat and social objectives. Analyzes biological and site physical factors that affect growth and yield potential, opportunities for operational activities and expected results. Compares differences among deciduous species that affect responses to silvicultural stand manipulation.

Prerequisite: FOR 204 or Junior Standing
Typically offered in Fall only

FOR 411 Forest Tree Genetics and Biology (3 credit hours)
Genetics as it is applied in forest management for both conifers and hardwoods. The variation, evolution and genetics of forest trees. Methods for selection, breeding, seed production, and vegetative propagation. Exotics, wood properties, and tree improvement as a forest management tool.

Prerequisite: Junior standing
Typically offered in Spring only

FOR 414 World Forestry (3 credit hours)
Management of global forest resources; distribution and trends in forest cover; role of forests in economic development; international production and trade of forest products; current policy issues, including tropical deforestation, certification, and carbon sequestration; social forestry and non-timber forest products; international institutions and aid for conservation and development; identification and evaluation of sources of current information on global forestry issues.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

FOR 415 World Forestry Study Tour (1 credit hours)
Field trip to Mexico and/or Central America for seven days over spring break. Examine tropical forestry issues through field visits to timber concessions, plantations, nurseries, wood products firms, protected areas, and agroforestry projects; meetings with representatives of forest research institutes, government agencies, timber industry, cooperatives, and environmental organizations; and interaction with local people. Fee for field trip determined annually.Offered during spring break, as aone week field trip to Mexico and/or Central America.

Corequisite: FOR 414
Typically offered in Spring only

FOR 420/NR 420/FOR 520/NR 520 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Spring only

FOR 422/FOR 522 Consulting Forestry (3 credit hours)
Forest land acquisition and ownership: ownership, appraisal, legal considerations, financial management and planning. Producing forest resources: timber, wildlife, recreation, farm products, water, minerals, specialty products, and development. Marketing forest resources: timber, recreation, farm leases, minerals, specialty products, and developed property. Forest resources consulting: forms of organization, pricing of services, consultant client relationships (Law of Agency), professional ethics and continuing education.

Prerequisite: Senior standing in Forest Management
Typically offered in Fall only

FOR 430 Forest Health and Protection (3 credit hours)
This course will introduce students to the major insect and disease problems of North American forests, both native and introduced, with an emphasis on the recognition and management of pests and the damage they cause. Wild land fire, invasive plants, and climate change and their interactions with forest insect and diseases will also be covered.

Prerequisite: PB 200 or BIO 181 or BIO 183 or FOR 260 or BIO 360 or PB 360 (or other Biology or Plant Biology course).
Typically offered in Fall only

FOR 434/FOR 534 Forest Operations and Analysis (3 credit hours)
Management science and operational techniques in forestry. Logging road layout and construction, and machine systems: harvesting machine optimization and selection. Harvesting, production and forest planning. Decision and inventory theory, and other techniques for solving problems typically encountered in forest operations management. Required overnight weekend field trip.

Junior standing or above
Typically offered in Spring only

FOR 472 Forest Soils (4 credit hours)
The course will evaluate how forest soils form in the natural environment, but also their relations to forest management and sustainability. Coursework includes soil physical, chemical, and biological properties, and also special topics such as soil fertility, soil formation, soil taxonomy and classification, soil organic matter management, and soil C and N cycles. There are many factors that contribute to forest soils differing from traditional cultivated soils. These factors will be explored in addition the variation in management styles for forest soils. The goal of this course is to gain an understanding of the basic properties and processes of forest soils as well as evaluate the role of these soils in sustainable forest management. Two Saturday Labs will be required.

Prerequisites: CH 101 & CH 102 and PB 200 or BIO 181
Typically offered in Spring only

FOR 491/NR 491 Special Topics in Forestry and Related Natural Resources (1-4 credit hours)
Independent (or group) study or research of a forestry or related natural resources topic with a faculty supervisor of the student's choice. Also courses offered on a trial basis.

Typically offered in Fall and Spring

FOR 493 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the advanced level developed under the direction of a faculty member. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FOR 494 Independent Study in Forest Management (1-6 credit hours)
Independent Study for Forest Management students at the advanced level developed under the direction of a faculty member. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

FOR 501 Dendrology (3 credit hours)
Identification and natural history of eastern woody species with studies of their taxonomic classification, physical characteristics, and typical habits. Laboratories stress sight recognition and use of identification keys and trips to natural forest communities.

Prerequisite: PB 200
Typically offered in Fall only

FOR 502 Forest Measurements (1 credit hours)
One-third semester mini-course. Forest measurements covering principles, terminology, and practical field applications. Land area measurement, units of timber measure (cubic feet, cords, weight, board feet), estimating volume of standing trees, sampling techniques for forest inventory (strips, plots, points), measures of site quality and stand density, methods for projecting future timber volumes.

Typically offered in Fall only

FOR 503 Tree Physiology (1 credit hours)
One-third semester mini-course. Fundamental principles of physiological processes in forest trees affecting tree and stand growth and development in natural forests and managed plantations. Concepts of whole plant physiological processes includingphotosynthesis, respiration, water relations, nutrition, periodic growth, sexual and vegetative reproduction, and seedling quality with forestry examples of each process.

Prerequisite: Graduate standing
Typically offered in Fall only

FOR 504 The Practice of Silviculture (3 credit hours)
The theory and practice of stand regeneration, controlling composition, intermediate treatments and growth; application of the knowledge of silvics in the management of stands. Emphasis on forest communities of North America. Co-requisite course is FOR 506: Silviculture Laboratory (Optional)

Typically offered in Spring only

FOR 505/FOR 405 Forest Management (4 credit hours)
Fundamental principles and analytical techniques necessary in the planning, management and optimization of forest operations. Formulation of objectives and constraints, yield forecasting, forest regulation, procurement and marketing, inventory methods, and management plan preparation. Written and oral reporting.

Prerequisite: FOR 304, FOR 319, FOR 374
Typically offered in Fall only

FOR 506 Silviculture Laboratory (1 credit hours)
Development of site specific prescriptions to establish stands for a wide variety of objectives, including fiber, water, wildlife, recreation and health. Emphasis on forest communities of North America.

Corequisite: FOR 504
Typically offered in Spring only

FOR 507 Silviculture Mini Course (1 credit hours)
One-third semester mini-course. A condensed version of silviculture. Ecological processed affecting establishment and growth of forest stands with particular emphasis on forest types of southeastern United States. Forest stand productivity, how productivity influenced by site, stand, climatic factors, and application of site specific prescriptions to establish and manipulate composition, growth, and health of forest stands.

Typically offered in Spring only

FOR 508/FOR 408 Hardwood Management (3 credit hours)
Examines characteristics of and requirements for successfully manipulating stands of deciduous trees to meet specific economic, habitat and social objectives. Analyzes biological and site physical factors that affect growth and yield potential, opportunities for operational activities and expected results. Compares differences among deciduous species that affect responses to silvicultural stand manipulation.

Prerequisite: FOR 204 or Junior Standing
Typically offered in Fall only

FOR 509 Forest Resource Policy (1 credit hours)
One-third semester mini-course. Principles of forest policies and processes. Political processes, institutional and interest group participation, forestry laws and programs, current issues, and policy analyses.

Typically offered in Spring only

FOR 510 Introduction to GPS (1 credit hours)
One-third semester mini-course. Introduction to collection and use of mapping grade global positioning satellite systems data. Includes review of cartographic properties, mission planning, hands-on collection of GPS points, lines, and areas, differential correction, editing, and exporting GPS files to a GIS.

Typically offered in Fall only

FOR 513 Silviculture for Intensively Managed Plantations (3 credit hours)
This course provides an up-to-date understanding of the ecological and physiological bases of forest stand productivity and a silvicultural systems framework to use this knowledge for making site specific prescriptions that are cost effective and environmentally sustainable.

Prerequisite: FOR 507
Typically offered in Spring only

FOR 514 Woodland Stewardship (3 credit hours)
An introduction and overview of non-industrial private forestry in the Southeast United States with emphasis on active forest management. Topics include history of human impact on forests, evolution of forest, forestry practices, timber and non timber management objectives, financial aspects of forest land management, and management planning. One required all day field trip.

Typically offered in Fall only

FOR 515/ECG 515 Environmental and Resource Policy (3 credit hours)
Application of price theory and benefit-cost analysis to public decisions related to resources and environment. Emphasis on evaluation of water supply and recreation investments, water quality management alternatives, public-sector pricing, common property resources and optimum management of forest and energy resources.

Prerequisite: EC(ARE) 301 or 401
Typically offered in Spring only

FOR 519 Forest Economics (3 credit hours)
Economics applied to problems in forest management, including timber demand and supply models, optimal rotation length, benefit-cost analysis of forestry projects, impacts of forest taxation and consideration of non-market forest goods and services.

Prerequisite: Basic course in economics
Typically offered in Fall only

FOR 520/NR 520/FOR 420/NR 420 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Spring only

FOR 522/FOR 422 Consulting Forestry (3 credit hours)
Forest land acquisition and ownership: ownership, appraisal, legal considerations, financial management and planning. Producing forest resources: timber, wildlife, recreation, farm products, water, minerals, specialty products, and development. Marketing forest resources: timber, recreation, farm leases, minerals, specialty products, and developed property. Forest resources consulting: forms of organization, pricing of services, consultant client relationships (Law of Agency), professional ethics and continuing education.

Prerequisite: Senior standing in Forest Management
Typically offered in Fall only

FOR 531 Wildland Fire Science (3 credit hours)
Physical, chemical, biological, and ecological processes associated with wildland fire, particular emphasis on fire behavior, fuels, weather, climate and the associated effects on ecology, management, fire suppression, prescribed fire, and smoke emissions and exposure. Fire's effect on national policy, social and natural history of North America. In-depth exercises in fire and smoke modeling using established predictive systems.

Typically offered in Spring only

FOR 532 Wildland Firefighter (3 credit hours)
National Wildfire Coordination Group Firefighter Type II Certification, including study of the National Incident Command Systems (ICS-100), Human Dimensions in the Wildland Fire Service (L-180) Introduction to Wildland Fire Behavior (S-190), Firefighting Safety and Training (S-130). Weekly reading seminar, lectures and problem sessions. Last 4 weeks of semester will be prescribed fire planning and field implementation of methodologies learned in course.

Typically offered in Fall only

FOR 534/FOR 434 Forest Operations and Analysis (3 credit hours)
Management science and operational techniques in forestry. Logging road layout and construction, and machine systems: harvesting machine optimization and selection. Harvesting, production and forest planning. Decision and inventory theory, and other techniques for solving problems typically encountered in forest operations management. Required overnight weekend field trip.

Junior standing or above
Typically offered in Spring only

FOR 540 Advanced Dendrology (3 credit hours)
Identification and life histories of native and naturalized woody plants. Use of taxonomic manuals and literature. Identification of problematic groups. Concentration on North America, with discussion of other continents. Overnight field trips to natural forest communities.

Prerequisite: BO 403 or FOR 339
Typically offered in Spring only

FOR 561 Forest Communities of the Southeastern Coastal Plain (1 credit hours)
Species composition, distribution, site requirements, and succession of principal forest communities of southeastern Coastal Plain. Identification of important member plant species. Overnight field trips to typical examples.

Prerequisite: FOR 212, FOR 501
Typically offered in Summer only

FOR 562 Forest Communities of the Southern Appalachians (1 credit hours)
Species composition, distribution, site requirements, and succession of principal forest communities of southern Appalachians. Identification of important member plant species. Overnight field trips to typical examples.

Prerequisite: FOR 212, FOR 501
Typically offered in Summer only

FOR 565 Plant Community Ecology (4 credit hours)
Consideration of structure and function of terrestrial vascular plant communities, with emphasis on both classical and recent research. Measurement and description of community properties, classification, ordination, vegetation pattern in relation to environment, ecological succession and a survey of vegetation of North America.

Prerequisite: Undergraduate Ecology Course
Typically offered in Spring only

FOR 574 Forest Mensuration and Modeling (3 credit hours)
Study of mathematical functions required for quantifying the yield of timber and non-timber products. Procedures for planning, conducting, and analyzing forest inventories, use of mathematical models to estimate growth and yield of forest stands and non-timber products for management decisions.

Prerequisite: ST 511 or equivalent; College Calculus preferred
Typically offered in Fall only

FOR 575 Advanced Terrestrial Ecosystem Ecology (3 credit hours)
Views organisms and physical environment as integrated system. Outlines processes governing assimilation and cycling of energy, carbons, nutrients, and water. Evaluates ecosystem responses to intensive management, global climate change, air pollution, biofuels production, fragmentation, large-scale land use change. Illustrates application of ecosystem science approach to important regional and global questions through scaling of empirical, ecosystem-level data, ongoing research. Provides experience in hypothesis testing and experimental design, data analysis and interpretation, proposal development, and publication for research professionals. Graduate Standing.

Typically offered in Spring only

FOR 583 Tropical Forestry (3 credit hours)
Principles of tropical ecology, dendrology and agroforestry. Primary emphasis on establishment and management of tropical plantations with lesser emphasis on natural stands. Operation and management of tropical nurseries.

Prerequisite: Senior standing
Typically offered in Fall only

FOR 595 Special Topics (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis.Also used to develop and test new 500-level courses.

Typically offered in Fall, Spring, and Summer

FOR 601 Graduate Seminar (1 credit hours)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

Typically offered in Fall and Spring

FOR 603 Research Methods in Forestry and Environmental Resources (1 credit hours)
Philosophy and objectives of scientific research and steps in the research process. Basic and applied research, inductive and deductive reasoning and need for hypothesis development and testing as a basis for scientific research. Special emphasis on preparation of study plans, graduate theses, published articles and technical presentations.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

FOR 610 Special Topics In Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis.Also used to develop and test new 500-level courses.Credits Arranged.

Typically offered in Fall, Spring, and Summer

FOR 630 Independent Study in Forestry (1 credit hours)
Independent study in Forestry under the supervision of a Forestry and Environmental Resources faculty member. Restricted to graduate students in the Department of Forestry and Environmental Resources with consent of the supervising faculty. May not be taken in the first semester of graduate study.

Typically offered in Fall, Spring, and Summer

FOR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FOR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

FOR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

FOR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FOR 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

FOR 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

FOR 713 Advanced Topics In Silviculture (3 credit hours)
Critical examination of selected silvicultural topics, with special emphasis on concepts and phenomena distinguishing forests from other biotic communities and silviculture from other fields of applied biology. Emphasis on intensive silviculture in United States and selected international locations. A required written research proposal.

Prerequisite: FOR 304
Typically offered in Fall only

FOR 725/GN 725 Forest Genetics (3 credit hours)
Application of genetic principles to silviculture, management and wood utilization. Emphasis on variation in wild populations, the bases for selection of desirable qualities and fundamentals of controlled breeding.

Typically offered in Spring only

FOR 726/CS 726/ANS 726 Advanced Topics In Quantitative Genetics and Breeding (3 credit hours)
Advanced topics in quantitative genetics pertinent to population improvement for quantitative and categorical traits with special applications to plant and animal breeding. DNA markers - phenotype associations. The theory and application of linear mixed models, BLUP and genomic selection using maximum likelihood and Bayesian approaches. Pedigree and construction of genomic relationships matrices from DNA markers and application in breeding.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Spring only

FOR 727 Tree Improvement Research Techniques (3 credit hours)
Research methods involved in forest tree breeding and genetics programs. Emphasis on laboratory, greenhouse and field research techniques. Stress also on summary and presentation of research results.

Prerequisite: FOR 411 or GN 411
Typically offered in Spring only

FOR 728 Quantitative Forest Genetics Methods (3 credit hours)
Applications of basic quantitative genetic methods in forest tree breeding and genetic research. Principles and procedures for partitioning experimental variance, estimating genetic parameters from different mating and test designs. Predicting breeding value and gain and developing breeding strategies.

Prerequisite: GN 703, ST 701
Typically offered in Fall only

FOR 734 Advanced Forest Management Planning (3 credit hours)
History, principles, structures and use of modern forest management planning and decision-making techniques. Emphasis on optimization procedures and public forest management.

Prerequisite: FOR 405 or FOR 434 or OR 501, Corequisite: FOR 772
Typically offered in Spring only

FOR 750 Ecological Restoration (3 credit hours)
Historical bases and philosophical examination of concepts of ecosystem restoration. Mechanics of restoring soils, hydrology, plant community composition and structure, and landscape levels ecosystem functions. Quantitative evaluations of restoration success.

Prerequisite: BO 360, SSC 200, Corequisite: BO 565
Typically offered in Spring only

FOR 753 Environmental Remote Sensing (3 credit hours)
Principles and applications of remote sensing technology to earth resources and environmental studies. Electromagnetic energy, data acquisition platforms, sensors and scanners, processing of digital remotely sensed data, error analysis and accuracyassessments, and integration of remotely sensed data with other data types used in natural resource management.

Prerequisite: FOR 353
Typically offered in Fall only

FOR 795 Advanced Special Topics in Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis.Also used to develop and test new 700-level courses.

Typically offered in Fall and Spring

FOR 801 Seminar (1 credit hours)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

Typically offered in Fall and Spring

FOR 803 Research Methods in Forestry and Environmental Resources (1 credit hours)
Philosophy and objectives of scientific research and steps in the research process. Basic and applied research, inductive and deductive reasoning and need for hypothesis development and testing as a basis for scientific research. Special emphasis onpreparation of study plans, graduate theses, published articles and technical presentations.

Prerequisite: Grad. standing
Typically offered in Fall only

FOR 810 Special Topics In Forestry (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis.Also used to develop and test new 800-level courses.

Typically offered in Fall, Spring, and Summer

FOR 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

FOR 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FOR 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

FOR 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

Genetic Engineering and Society (GES)

GES 506/ENT 506 Principles of Genetic Pest Management (3 credit hours)
Introduction to the biological aspects of genetic pest management (GPM). Genetic techniques for GPM, including historical uses (such as the sterile insect technique) and approaches that are currently in development. Practical issues relating to the deployment of GPM, including ecological and economic considerations.

Typically offered in Fall only

GES 508/COM 508 Emerging Technologies and Society (3 credit hours)
Provides frameworks for understanding emerging technologies and their social, political, and cultural contexts. Presents historical case studies, ethnographic accounts, and theoretical perspectives that introduce students to ways of thinking about science and technology, nature and culture, and democracy and expertise. Graduate standing is required.

Typically offered in Spring only

GES 591 Special Topics in Genetic Engineering and Society (1-6 credit hours)
Special topics and experimental course offerings in Genetic Engineering and Society.

Typically offered in Fall, Spring, and Summer

Genetics (GN)

GN 301 Genetics in Human Affairs (3 credit hours)
Appreciation and understanding of genetics in everyday life. Topics include basic principles of transmission genetics, molecular genetics, population genetics, and the effects of the environment on gene expression and phenotype. Applications of genetics in human development and disorders, genetic testing for medical and forensic purposes, and genetic engineering will be covered. Basic principles as well as ethical, legal, social, and public health issues will be covered.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

GN 311 Principles of Genetics (4 credit hours)
Basic concepts and principles of prokaryotic and eukaryotic genetics. Mendelian inheritance, polygenic inheritance, linkage and mapping, chromosome aberrations, population genetics, evolution, DNA structure and replication, gene expression, mutation, gene regulation, extranuclear inheritance, bacterial and viral genetics, and recombinant DNA technology.

Prerequisite: BIO 183 or ZO 160
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

GN 312 Elementary Genetics Laboratory (1 credit hours)
Genetic experiments and demonstrations using a variety of bacterial, plant and animal organisms. Mendelian inheritance, linkage analysis, population genetics, cytogenetics, biochemical genetics, DNA isolation, electrophoresis, and Southern blotting.

Corequisite: GN 311
Typically offered in Fall and Spring

GN 421/GN 521 Molecular Genetics (3 credit hours)
Biological macromolecules and their interactions, DNA topology, eukaryotic genome structure, chromatin and chromosome structure, transcription and transcription regulation, epigenetics, RNAi and RNA processing, recombinant DNA technology, genetic transformation and cloning of plants and animals. Bacteria, viruses, plants, animals and fungi as genetic systems. Students cannot receive credit for both GN 421 and GN 521.

Prerequisite: C- or better in GN 311
Typically offered in Fall and Spring

GN 423 Population, Quantitative and Evolutionary Genetics (3 credit hours)
This course is an introduction to population, quantitative and evolutionary genetics. This course will acquaint students with basic population genetics models. The course will cover genetic variation; measures of genetic variation; basic and advanced topics of selection; ecological genetics; inbreeding; genetic drift and effective population size; mutation; neutral theory and coalescence; gene flow and population structure; linkage disequilibrium and recombination; quantitative genetics; heritability;' quantitative trait loci; molecular population genetics and evolution.

Prerequisite: GN 311 and (MA 131 or MA 141)
Typically offered in Spring only

GN 425 Advanced Genetics Laboratory (2 credit hours)
This is a challenging advanced genetics laboratory designed to provide research and communication training and in-depth understanding of modern genetics through hands-on activities. Students will participate in a semester-long supervised research project in contemporary genetics using a model genetic organism and state-of-the-art techniques. The project will be directly related to research in the coordinating faculty member's laboratory. The project will require literature review, hypothesis development, experimental design and execution, data analysis and presentation of results in written and oral form.

Prerequisite: GN 312; Corequisite: GN 421
Typically offered in Fall and Spring

GN 427 Introductory Bioinformatics (3 credit hours)
This course is an introduction to bioinformatics for genetic and biological sciences. The course will provide a foundation in biological computing that includes command line interfaces, reformatting data, creating and editing graphics, automating analyses and database access, and scripting in biological programming languages used for bioinformatics such as Python, Perl, and R. Laptop required.

Prerequisite: GN 311 and (MA 131 or MA 141) with grades of C- or better
Typically offered in Fall only

GN 428 Introduction to Machine Learning in Biology (3 credit hours)
New techniques in genomics have revolutionized biology, but generate large quantities of data that present challenges in extracting signal from noise. This course will provide students the basic skills to manipulate and integrate different types of biological datasets and to learn how to mine them using data analysis tools ranging from basic to state of the art. Machine learning methods provide a framework to analyze vast amounts of biological information and extract meaningful signals. By the end of the semester, students will have had exposure to a variety of modern machine learning tools for classification and prediction. We will focus on exploration of DNA data (with millions of variants), expression data (> 20,000 genes), and microbiome data (thousands of features), combined with various disease/experimental measurements. The course will cover the basics of loading and exploring datasets using visualization, followed by basic machine learning basic methods including classification and regression algorithms.

Prerequisite: C- or better in GN 311 and C- or better in MA 131 or MA 141 and C- or better in ST 311
Typically offered in Spring only

GN 434 Genes and Development (3 credit hours)
Overview of pivotal experiments in embryology and developmental genetics; genes and genetic pathways that control development in animal model systems and humans; focus on the application of molecular genetic approaches to the study of genes and development; reading and discussion of primary scientific literature. Cannot receive credit for both GN 434 and BIO 361.

Prerequisite: C- or better in GN 311
Typically offered in Fall, Spring, and Summer

GN 441/GN 541 Human and Biomedical Genetics (3 credit hours)
This course is an in depth study of human and biomedical genetics and the role of genetics in human health and disease. The course will aquaint students with contemporary knowledge of genetics in disease causation and susceptibility, the use of model organisms to inform human biology and contemporary topics in human genetics research like epigenetics, therapeutic cloning, gene therapy, role of genetics in response to drugs and predictive medicine. Credit cannot be given for both 441 and 541.

Prerequisite: C- or better in GN 421
Typically offered in Fall only

GN 450/GN 550 Conservation Genetics (3 credit hours)
The main objective of this course is to expose upper division undergraduate students and graduate students to conservation genetic tools and applications. Students will learn the genetic and genomic theory and methods commonly used in conservation and management of species. In addition, the course will provide hands-on experience working on current conservation projects here at North Carolina State University. Working in groups, the students will collect, run, and analyze those data for a scientific paper. The final project for all students will be a conservation genetic grant proposal.

Prerequisite: GN 311
Typically offered in Spring only

GN 451 Genome Science (3 credit hours)
Genomic approaches with a foundation in classical and molecular genetics, including both historical strategies used in early major genome projects, and cutting edge contemporary methods for genomics and systems biology; the sequencing, assembly, and annotation of genomes and transcriptomes; use of genomic methods to tackle problems in epigenetics, metagenomics, and proteomics; application to a wide variety of species and biological questions, including evolution and human health; reading, discussion, and presentation of current scientific literature.

Prerequisite: C- or better in GN 311
Typically offered in Spring only

GN 453 Personal Genomics (3 credit hours)
This course will teach students the principles and practices of data analysis associated with human genetic research. Students will gain an understanding of how DNA variation explains human ancestry and how DNA variation is used to identify genes affecting complex traits. Students will analyze real data sets to determine human ancestry and quantitative traits using computational tools presented in the course.

Prerequisite: C- or better in GN 311 and C- or better in ST 311
Typically offered in Spring only

GN 456 Epigenetics, Development, and Disease (3 credit hours)
Scientists are just beginning to fully appreciate how our genes and the environment interact to influence human development and disease. The emerging field of epigenetics offers new insights into these complex connections. Epigenetics is the study of heritable changes in gene expression and phenotypes caused by mechanisms other than changes in the underlying DNA sequence. Topics may include imprinting, mechanisms driving epigenetic modifications, how environmental exposures may influence your grandchildren's health, why identical twins exhibit differences in behavior or disease susceptibility, and epigenetic and environmental bases of diverse diseases. We will also discuss experimental strategies for studying epigenetics. JR standing.

Prerequisite: B or better in GN 311
Typically offered in Spring only

GN 461 Advanced Bioinformatics (3 credit hours)
This course provides in-depth experience in applying bioinformatic computing techniques to experimental data with a focus on the genetic and biological sciences. The course will provide experience in genome sequence analysis and assembly, extracting, manipulating and visualizing genetic and molecular data, analysis of macromolecular sequences, and generating and visualizing phylogenetic date. Laptop required.

Prerequisite:GN 427 and ST 311 with grades of C- or better
Typically offered in Spring only

GN 490 Genetics Colloquium (1 credit hours)
This course will involve critical study of research in genetics. Students will evaluate primary research publication on prepared topics assigned by instructor, with emphasis on review of recent and current research.

Prerequisite: GN 421
Typically offered in Spring only

GN 496 Genetics Research Experience (3 credit hours)
GN 496 provides an opportunity for students to gain real-world experience by conducting independent research in a genetics research program. A minimum of 135 hours must be completed for the three hours credit. The experience must be arranged by the student and approved by the Director of the Undergraduate Genetics Program in advance of beginning the work. To gain approval, students must submit the completed GN 496 Contract, signed by their GN 496 supervisor (Research Mentor) and by their academic advisor. The student is required to write a research paper evaluating the results of their project. In addition to the work described in the contract, students will complete a series of reflective written assignments during and at the end of their GN 496 experience.

Minimum of sophomore standing. Limited to Genetics Majors and Genetics Minors. Students must submit required signed course contract prior to registration.
Typically offered in Fall, Spring, and Summer

GN 497 Genetics Teaching Experience (3 credit hours)
GN 497 provides an opportunity for students to gain experience in an aspect of genetics education research and/or developing, implementing, and evaluating the effectiveness of materials for use in the genetics classroom. A minimum of 135 hours must be completed for the three hours credit. The experience must be arranged by the student and approved by the Director of the Undergraduate Genetics Program in advance of beginning the work. To gain approval, students must submit the completed GN 497 Contract, signed by their GN 497 Teaching Mentor and by their academic advisor. The student is required to write a scientific paper evaluating the results of their project. In addition to the work described in the contract, students will complete a series of reflective written assignments during and at the end of their GN 497 experience.

Minimum of sophomore standing. Limited to Genetics Majors and Genetics Minors. Students must submit required signed course contract prior to registration.
Typically offered in Fall, Spring, and Summer

GN 521/GN 421 Molecular Genetics (3 credit hours)
Biological macromolecules and their interactions, DNA topology, eukaryotic genome structure, chromatin and chromosome structure, transcription and transcription regulation, epigenetics, RNAi and RNA processing, recombinant DNA technology, genetic transformation and cloning of plants and animals. Bacteria, viruses, plants, animals and fungi as genetic systems. Students cannot receive credit for both GN 421 and GN 521.

Prerequisite: C- or better in GN 311
Typically offered in Fall and Spring

GN 541/GN 441 Human and Biomedical Genetics (3 credit hours)
This course is an in depth study of human and biomedical genetics and the role of genetics in human health and disease. The course will aquaint students with contemporary knowledge of genetics in disease causation and susceptibility, the use of model organisms to inform human biology and contemporary topics in human genetics research like epigenetics, therapeutic cloning, gene therapy, role of genetics in response to drugs and predictive medicine. Credit cannot be given for both 441 and 541.

Prerequisite: C- or better in GN 421
Typically offered in Fall only

GN 550/GN 450 Conservation Genetics (3 credit hours)
The main objective of this course is to expose upper division undergraduate students and graduate students to conservation genetic tools and applications. Students will learn the genetic and genomic theory and methods commonly used in conservation and management of species. In addition, the course will provide hands-on experience working on current conservation projects here at North Carolina State University. Working in groups, the students will collect, run, and analyze those data for a scientific paper. The final project for all students will be a conservation genetic grant proposal.

Prerequisite: GN 311
Typically offered in Spring only

GN 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

GN 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall only

GN 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's Student
Typically offered in Fall and Spring

GN 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's Student
Typically offered in Fall and Spring

GN 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

GN 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's Student
Typically offered in Fall only

GN 701 Molecular Genetics (3 credit hours)
A discussion of the structure and function of genetic material at a molecular level. Consideration of both prokaryotic and eukaryotic systems. The aim to describe genetics in terms of chemical principles.

Prerequisite: GN 311
Typically offered in Fall only

GN 702 Cellular and Developmental Genetics (3 credit hours)
Regulation of genes involved in cellular function, differentiation and development in eukaryotes. Presentation of biological systems and model organisms used to study genetic control of cellular and developmental processes.

Prerequisite: GN 701
Typically offered in Spring only

GN 703 Population and Quantitative Genetics (3 credit hours)
Mutation and origin of genetic variation. Measuring genetic variation in natural populations. Gene and genotype frequencies. Hardy-Weinberg equilibrium. Values, means, genetic and environmental variance, heritability of quantitative traits. Random genetic drift and inbreeding. Natural and artifical selection. Theory and tests of models of maintenance of genetic variation. Molecular evolution of genes and proteins. Genome evolution.

Prerequisite: GN 311 and ST 512
Typically offered in Spring only

GN 713/ANS 713 Quantitative Genetics and Breeding (3 credit hours)
Quantitative and population genetic theory of breeding problems; partitioning of genetic variance, maternal effects, genotype by environment interaction and genetic correlation; selection indexes; design and analysis of selection experiments; marker-assisted selection.

Prerequisite: GN 509, ST 512
Typically offered in Fall only

GN 720/HS 720/CS 720 Molecular Biology In Plant Breeding (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Understanding of the relationship between genes and crop traits. Principles and molecular mechanisms of crop traits, and their applications to solve breeding problems and improve crop traits, which include heterosis, male/female sterility, self-incompatibility, polyploidy, double haploid, protoplast fusion, random mutagenesis, plant regeneration, transgenic breeding, advanced genome editing for breeding, gene silencing, gene activation, gene drive, plant synthetic biology, metabolic engineering, epigenetics for trait improvement, gene stacking, decoy and R genes, and bioconfinement.

P: CS 211 or GN 311 or equivalent, and PB 421 or equivalent.
Typically offered in Spring only

GN 721/ST 721 Genetic Data Analysis (3 credit hours)
Analysis of discrete data, illustrated with genetic data on morphological characters allozymes, restriction fragment length polymorphisms and DNA sequences. Maximum likelihood estimation, including iterative procedures. Numerical resampling. Development of statistical techniques for characterizing genetic disequilibrium and diversity. Measures of population structure and genetic distance. Construction of phylogenetic trees. Finding alignments and similarities between DNA sequences. Locating genes with markers.

Prerequisite: ST 430 and GN 311
Typically offered in Spring only

GN 725/FOR 725 Forest Genetics (3 credit hours)
Application of genetic principles to silviculture, management and wood utilization. Emphasis on variation in wild populations, the bases for selection of desirable qualities and fundamentals of controlled breeding.

Typically offered in Spring only

GN 735 Functional Genomics (3 credit hours)
Methodology of experimental genomics; genome sequencing, gene expression arrays, genomic screens, proteomics. Aims and achievements of microbial, plant, animal, human genome projects. Applications of genomics including parasitology, breeding, functional genomics, evolutionary genetics. Interface with bioinformatics, data technology.

Prerequisite: GN 701
Typically offered in Spring only

GN 745/HS 745/CS 745 Quantitative Genetics In Plant Breeding (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.

Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

GN 746/HS 746/CS 746 Cytogenetics in Plant Breeding (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

Typically offered in Spring only

GN 756/ST 756 Computational Molecular Evolution (3 credit hours)
Phylogenetic analyses of nucleotide and protein sequence data. Sequence alignment, phylogeny reconstruction and relevant computer software. Prediction of protein secondary structure, database searching, bioinformatics and related topics. Project required.

Prerequisite: GN 311 and ST 511
Typically offered in Fall only

GN 757/ST 757/HS 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.

Prerequisite: ST 511
Typically offered in Fall only

GN 758/MB 758 Microbial Genetics & Genomics (3 credit hours)
Structure and function in microbial genetics, with emphasis on microbial genome organization, stable maintenance and evolution. DNA mutation and repair pathways, transcriptional and translational regulation, DNA replication and recombination and characterization of recombinant DNA molecules. Applications of genetic and genomic analysis methods to microbial processes, including strain construction, genome manipulation, and enhancement of gene expression.

Prerequisite: BCH 451 or GN 311
Typically offered in Spring only

GN 761/PB 761/BCH 761 Advanced Molecular Biology Of the Cell (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

Typically offered in Spring only

GN 768/BCH 768 Nucleic Acids: Structure and Function (3 credit hours)
An advanced treatment involving integrated approaches to biological problems at the molecular level, encompassing biochemistry, cell biology and molecular genetics. Broad, multidisciplinary approaches to solving research problems in biology and thecritical study of primary scientific literature, the development of a research proposal, oral presentations and class discussions.

Prerequisite: BCH 701 and 703
Typically offered in Spring only

GN 810 Special Topics in Genetics (1-6 credit hours)
Critical study of selected areas and special topics of current interest in genetics and related fields.

Typically offered in Fall and Spring

GN 820 Special Problems (1-6 credit hours)
Special topics designed for additional experience and research training.

Prerequisite: Advanced Graduate standing
Typically offered in Fall and Spring

GN 850 Professionalism and Ethics (1 credit hours)
The course is designed to give students background in professionalism, scientific ethics and responsible conduct of science. Topics include the role of the scientist in society, ethical theory, data acquisition and ownership, scientific midconduct,authorship, peer review, conflicts of interest and commitment, intellectual property, ethics of teaching and mentoring, ethical treatment of animal and human subjects, ethics of genetics research, job hunting and interviewing.

Prerequisite: Graduate standing
Typically offered in Fall only

GN 860/HS 860/CS 860 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Spring only

GN 861/HS 861/CS 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Fall only

GN 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

GN 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

GN 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

GN 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Geographic Information Systems (GIS)

GIS 205 Spatial Thinking with GIS (3 credit hours)
Spatial thinking and how it relates to the basic foundations of geospatial science and geographic information systems (GIS) are introduced. Students will learn to tell stories through maps using geographic information and geospatial data and analysis by applying spatial reasoning through a series of interactive assignments and discussions. Students will learn to define spatial problems and design solutions across a variety of disciplines, setting the stage for additional technical coursework in GIS and Geospatial Science.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

GIS 280 Introduction to GIS (3 credit hours)
This course provides an overview of the operations and functions of geographic information systems [GIS]. Students develop a fundamental understanding of geographic information management and analysis methods. Emphasis is placed on the nature of geographic information, working with spatial data, and elementary geospatial analysis and modeling techniques. Students learn effective operation of GIS software and gain exposure to GIS tools that support these emphasis areas. Extensive independent learning and computer experiences include online laboratory sessions, alongside optional online or in-person weekly help sessions.

Typically offered in Fall and Spring

GIS 295 Special Topics in Geospatial Information Science (1-4 credit hours)
Special Topics in Geospatial Information Science at the 200 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

GIS 501 Geospatial Professionalism (2 credit hours)
Students will examine a variety of topics critical to successful navigation of the geospatial profession, with an emphasis on map communication and presentation, interpreting geospatial research, the ethical, legal, and social implications (ELSI) of using spatial data, metadata concepts, and linking results to policy actions. Students will engage in several writing, presentation, and interpretation exercises.

Typically offered in Fall and Spring

GIS 510 Fundamentals of Geospatial Information Science and Technology (3 credit hours)
This course provides an advanced overview of how geographic information systems [GIS] facilitate data analysis and communication to address common geographic problems. Students improve spatial reasoning and problem definition expertise while emphasizing geographic data models and structures, data manipulation and storage, customization through programming, and the integration of geospatial analysis and modeling into project-based problem solving applicable to a variety of disciplines. Skilled application of both desktop and cloud-based GIS software supports these areas. Extensive independent learning and computer experiences include virtual laboratory sessions, alongside optional online or in-person weekly help sessions to facilitate student learning.

Prerequisite: Graduate Standing or PBS or Permission of Instructor
Typically offered in Fall and Spring

GIS 512 Introduction to Environmental Remote Sensing (3 credit hours)
Principles and hands-on techniques for processing and analyzing remotely sensed data for natural resource applications. Topics include review of the electromagnetic spectrum, pre-processing (georectification, enhancements and transformations), processing (visual interpretation, indices, supervised and unsupervised classification) and post-processing (masking, change analysis and accuracy assessment) of digital image data. This course will provide students with fundamental concepts and skills needed to pursue further studies in digital processing of remotely sensed data.

Typically offered in Fall and Spring

GIS 515 Cartographic Design (2 credit hours)
Principles of cartographic design and how to apply them to produce high-quality geographic information system (GIS) based maps. Successful students will acquire an understanding of map design and experience applying it with GIS software. Students produce project maps in both print and web media.

Prerequisite: GIS 510
Typically offered in Fall and Spring

GIS 517/LAR 517 GIS Applications in Landscape Architecture and Environmental Planning (3 credit hours)
Introduction to the methods and applications of geographic spatial modeling technology in landscape architecture and environmental planning.

Typically offered in Fall only

GIS 520 Spatial Problem Solving (3 credit hours)
Focus on spatial problem solving from a geographic information perspective. Students learn to solve spatial problems through advanced analysis using geospatial technologies, learn to integrate and analyze spatial data in various formats, and explore methods for displaying geographic data analysis results to guide decision making. All course materials are delivered through the Internet, with optional weekly on-campus and synchronous online help sessions.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 521 Surface Water Hydrology with GIS (3 credit hours)
The application of geographic information systems (GIS) to surface water modeling including stream and watershed delineations, regulatory wetlands jurisdiction determinations, and flood mapping. In addition students will develop spatial computation methods to support hydrological analysis in land use planning, landscape management, and engineering assessments.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 530 Spatial Data Foundations (3 credit hours)
This course focuses on geospatial information systems from a mathematical and information science perspective. We discuss theoretical frameworks for conceptualizing geographic data, including levels of measurement, data control, and the vector data and raster data paradigms. Then we discuss the geometric underpinnings of geospatial systems: representing data with geographic elements, spatial referencing systems, and projection. Next, we explore map-related topology and computational geometry concepts. Finally, we survey the algorithms for core spatial manipulations, such as interpolation and polygon operations.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 532 Geospatial Data Science and Analysis (2 credit hours)
This course provides the background and foundation necessary for geospatial analysis, with emphasis on spatial statistics. Introduction to data handling techniques, conceptual and practical geospatial data analysis and GIS in research will be provided. Problems raised by the use of geospatial data will be introduced to provide an awareness of issues, their consequences, and potential solutions. The focus of this course is application and interpretation of analytical methods, rather than derivation of techniques. Students will also explore the interoperability between open source analytical platforms (such as R) and GIS platforms, in addition to other open source software. Students should expect weekly assignments, lectures, and hands-on training using GIS and statistical software. Prior knowledge in basics of GIS is recommended. Topics include descriptive and inferential statistical methods for geospatial data.

Prerequisite: GIS 510
Typically offered in Spring only

GIS 535 Web and Mobile GIS Protocols (3 credit hours)
This course examines the design, development and deployment of web and mobile geospatial applications using internet and web-based protocols. Throughout the course, students will develop and deploy web and mobile GIS maps and applications relevant to their career using on-premises hosted infrastructure. Course participants will be required to complete assignments with data relevant to their interests. Additionally, students will search for and examine scientific and popular literature to understand how the course concepts are being employed and to foster ideas and discussion.

Prerequisite: GIS 510
Typically offered in Fall only

GIS 540 Geospatial Programming Fundamentals (3 credit hours)
This course provides fundamental skills for geospatial programming. Topics include calling geographic processing tools, batch processing, performing file i/o in an external computing language and building, graphical user interfaces and displays. To support these tasks, students learn basic programming concepts, such as pseudocode, flow-control, code re-use, and debugging. In the final project, students streamline GIS work-flow and customize GIS user interfaces. Familiarity with GIS software is required, but no prior programming experience is expected.

Prerequisite: GIS 510 or PA 541 or SSC 440
Typically offered in Fall and Spring

GIS 550 Geospatial Data Structures and Web Services (3 credit hours)
This course examines the spatial database models and structures used in geospatial information science and technology as well as the design and implementation of web and related mobile computing geospatial tools and systems. Students develop, evaluate, and deploy multiple spatial data models and web services that include connections to external data sources and systems.

Prerequisite: GIS 540
Typically offered in Fall and Spring

GIS 582/MEA 582 Geospatial Modeling (3 credit hours)
The course provides foundations in methods for GIS-based surface analysis and modeling. The topics include proximity analysis with cost surfaces and least cost paths, multivariate spatial interpolation and 3D surface visualization. Special focus is on terrain modeling, geomorphometry, solar irradiation, visibility, and watershed analysis. Students are also introduced to the basic concepts of landscape process modeling with GIS and to the principles of open source GIS. Introductory level knowledge of GIS or surveying/ geomatics principles is required.

Typically offered in Fall and Spring

GIS 584/MEA 584 Mapping and Analysis Using UAS (3 credit hours)
The course provides an overview of UAS mapping technology and its rules and regulations. The principles of UAS data collection are explained along with optional hands-on practice with in flight planning and execution. The main focus is on processing imagery collected from UAS using structure from motion techniques and deriving orthophoto mosaics and ultra-high resolution digital elevation models of land surface, vegetation and structures. More advanced topics include multi-temporal 3D data analysis, fusion with lidar data and 3D visualization.

Prerequisite: GIS 510 or GIS/MEA 582 or Permission of Instructor
Typically offered in Summer only

GIS 590 Geospatial Information Science Master's Project (3 credit hours)
This is the culmination course for The Master of Geospatial Information Science and Technology degree. This course provides students with the opportunity to demonstrate their accumulated degree skills and expertise by developing and communicating the solution to a complex geospatial problem through a Master's Capstone project. The project will include interoperable spatial and non-spatial data, web services, customized user interfaces and workflows completed in collaboration with a community partner. The student will design and manage a major project and professionally communicate their analysis and results to a public audience.

Prerequisite: GIS 550
Typically offered in Fall and Spring

GIS 595 Special Topics in Geospatial Information Science (1-6 credit hours)
Special Topics in Geospatial Information Science

Typically offered in Fall and Spring

GIS 601 Seminar in Geospatial Information Science (1 credit hours)
Seminar in Geospatial Information Science

Typically offered in Fall and Spring

GIS 609 Geospatial Forum (1 credit hours)
The Geospatial Forum brings together researchers, educators, practitioners, and students of the geospatial sciences in an exciting, weekly series of lively presentations and facilitated discussions centered upon frontiers in geospatial analytics and geospatial solutions to complex challenges. Live discussions are recorded and made available online for students.

Typically offered in Fall and Spring

GIS 610 Special Topics in Geospatial Information Science (1-6 credit hours)
Special Topics in Geospatial Information Science

Typically offered in Fall and Spring

GIS 630 Independent Study (1-3 credit hours)
Advanced topics not otherwise included in curriculum for advanced graduate students on a tutorial basis. Determination of credits and content by participating faculty in consultation with Director of Graduate Programs. Departmental consent required

Typically offered in Fall, Spring, and Summer

GIS 660 MGIST Professional Portfolio (1 credit hours)
This course will focus on creating an effective digital portfolio, including content selection, description and reflection, and web site organization and design. The digital portfolio will present personal MGIST program accomplishments to demonstrate individual competences through knowledge, skills, and abilities of a geospatial science professional. Intended for students in their last semester in the MGIST Program.

Restriction: Graduate Student in the MGIST Program; Corequisite: GIS 590
Typically offered in Fall and Spring

GIS 710 Geospatial Analytics for Grand Challenges (3 credit hours)
Examination of sustainable solutions to grand societal challenges using geospatial analytics. Emphasis is placed on the roles that location, spatial interaction, and multi-scale processes play in scientific discovery and communication. Discussion of seminal and leading-edge approaches to problem-solving is motivated by grand challenges such as controlling the spread of emerging infectious disease, providing access to clean water, and creating smart and connected cities. Students also engage in several written and oral presentation activities focused on data science communication skills and professionalization.

Typically offered in Fall only

GIS 711/CSC 711 Geospatial Data Management (3 credit hours)
Data management principles and technologies for efficient implementation of geospatial applications. This course introduces students to: spatial and temporal data types, data models, geometry models, spatial predicates, spatial access methods, and spatial query processing. In addition, students will be exposed to modern data management systems for geospatial application development and data integration principles. Prior GIS programming knowledge and knowledge of database management systems and SQL is preferred.

Typically offered in Spring only

GIS 712 Environmental Earth Observation and Remote Sensing (3 credit hours)
Focus is on passive electro-optical (microwaves, infrared and visible) remote sensing and will cover the physics of remote sensing, light interactions with Earth surface materials, limitations, advantages and disadvantages of passive remote sensing techniques, estimation of bio/geo-physical parameters from remote sensing data, and sensor performance and mission design for applications including hydrology, cryosphere, atmosphere-ocean dynamics, ecosystems and carbon cycle, and land use land cover change. Students should have introductory knowledge of GIS and remote sensing.

Typically offered in Fall only

GIS 713 Geospatial Data Mining (3 credit hours)
This course equips students with the theoretical background and practical computational skills required to use data mining methodologies, including clustering, PCA, spatial autocorrelation, neural networks, classification and regression trees, and high performance, open source geocomputation. The course is designed around, and pays particular attention to, approaches for data with spatial components. Students are expected to have a working knowledge of basic geographic principles, statistical principles, GIS, and remote sensing. Some experience with R programming would also be beneficial.

Typically offered in Fall only

GIS 714 Geospatial Computation and Simulation (3 credit hours)
This course focuses on theoretical concepts and computational methods that describe, represent and simulate the functioning of real-world geospatial processes. We define the general properties of geospatial computing and explain the role of simulations in analysis and understanding of observed spatial phenomena, testing of hypotheses and theories, and prediction of spatio-temporal systems behavior. We discuss the current methods and techniques for simulations using deterministic, stochastic and rule-based models as well as agent-based simulation of complex systems. Hands-on component of the course will cover implementation of simulations in GIS and advanced applications driven by the student's research. Some prior programming experience is expected along with exposure to geospatial modeling, such as in GIS/MEA 582 or equivalent.

Restriction: 15GAPHD or Permission of Instructor
Typically offered in Spring only

GIS 715 Geovisualization (3 credit hours)
This course focuses on visualization and interface design for geospatial analytics. With readings from textbooks and visualization literature, we'll discuss the applied science visualization, the human visual system, properties of light and color, visual salience, motion and space perception, human-computer interaction, and visual thinking processes at it relates to geospatial data. The course will also include hands-on exploration of free and open source geospatial data manipulation and geovisualization tools and interaction with current technologies within the Center for Geospatial Analytics' Geovisualization Laboratory. Some prior programming experience is preferred (GIS540 or equivalent).

Restriction: Graduate standing in Geospatial Analytics or Permission of Instructor
Typically offered in Spring only

GIS 790 Special Topics in Geospatial Analytics (1-6 credit hours)
Special Topics in Geospatial Analytics

Typically offered in Fall, Spring, and Summer

GIS 810 Special topics in Geospatial Analytics (1-6 credit hours)
Special topics in Geospatial Analytics

Typically offered in Fall, Spring, and Summer

GIS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Typically offered in Fall and Spring

GIS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Typically offered in Fall and Spring

Geography (GEO)

GEO 200 Principles of Geography (3 credit hours)
Basic ideas in the field of geography. The scope of geography as an academic field explored. Emphasis placed on mastery of geographic tools, e.g., maps, globes, and media materials and sources. Regional study of contemporary world.

GEP Social Sciences
Typically offered in Spring only

GEO 220/SOC 220 Cultural Geography (3 credit hours)
Investigates the world's past and present cultural diversity by studying spatial patterns of population, language, religion, material and non-material culture, technology and livelihoods, communities and settlements and political organization and interaction.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Summer only

Global Knowledge (GK)

GK 295 Global Knowledge Special Topics (1-3 credit hours)
Special topics course offering for the general education Global Knowledge category.

Global Public Health (GPH)

GPH 112 Wicked Problems, Wolfpack Solutions: Global Pandemic (2 credit hours)
Wicked Problems, Wolfpack Solutions is a shared academic experience designed for all students new to NC State. Each year, this course focuses on a current wicked problem, defined as a highly complex problem that can only be addressed through collaborative, multidisciplinary efforts. This course explores a wicked problem and possible solutions through the perspectives of NC State scholars representing many different areas of study and reflects NC State's commitment to inclusion of individuals and ideas from a broad diversity of backgrounds and experiences. GPH 112 focuses on the wicked problem of Global Pandemics.

R: New First-Year Students and New Transfer Students
GEP Interdisciplinary Perspectives
Typically offered in Summer only

GPH 201 Fundamentals of Global Public Health (3 credit hours)
Introduction to Public Health, providing a population-based perspective on disease and injury causation and prevention. Environmental, social, behavioral, and biological determinants of health and disease. Access to health services from a global perspective. Selected tools of disease control and health promotion and problems related to health-care delivery to society as a whole and to vulnerable populations.

Typically offered in Fall and Spring

GPH 404/ST 404 Epidemiology and Statistics in Global Public Health (3 credit hours)
This course will provide a general introduction to the quantitative methods used in global health, combining elements of epidemiology and biostatistics. The course will focus on linear and logistic regression, survival analysis, traditional study designs, and modern study designs. Students will learn fundamental principles in epidemiology, including statistical approaches, and apply them to topics in global public health. The course prerequisite is a B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or ST 371. In addition, a B- or better in GPH 201 is strongly recommended.

Pre-requisite: B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or 371
Typically offered in Fall only

GPH 425 Global Health and Physiology (6 credit hours)
This Study Abroad course is designed to immerse students in current physiology and disease research, tropical medicine, and global health issues while providing students with an opportunity to gain hands-on experience in the field of global health. Students spend three weeks on campus exploring scientific, policy, cultural, and governmental influences on global health before traveling to a developing country to participate in medical service outreach for 2 weeks. Application to and acceptance into this Study Abroad course and payment for travel is required for course participation.

Prerequisite: C- or better in BIO 212 or BIO 250 of BIO 240 or BIO 245
Typically offered in Summer only

Graduate Economics (ECG)

ECG 515/FOR 515 Environmental and Resource Policy (3 credit hours)
Application of price theory and benefit-cost analysis to public decisions related to resources and environment. Emphasis on evaluation of water supply and recreation investments, water quality management alternatives, public-sector pricing, common property resources and optimum management of forest and energy resources.

Prerequisite: EC(ARE) 301 or 401
Typically offered in Spring only

ECG 528/FIM 528/MA 528 Options and Derivatives Pricing (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.

Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only

ECG 530 Topics in Labor Economics (3 credit hours)
This course covers topics in labor economics including labor supply, labor demand, human capital, household production, discrimination, and immigration. The course textbook will be supplemented with readings from academic research papers. Students will learn how empirical research evaluates the predictions of economic theory and the impact of public policy. Students will gain an understanding of how to read and critique empirical research by applying the theory and measurement techniques developed by economists.

Prerequisites: ECG 505 and ECG 561
Typically offered in Spring only

ECG 537 Health Economics (3 credit hours)
Microeconomic analysis of public and private policy issues concerning health care financing and delivery in United States including: choice under conditions of asymmetric information; health insurance; performance of physician, hospital, long-term care and pharmaceutical markets.

Prerequisite: EC(ARE) 401 or ECG 700
Typically offered in Fall only

ECG 540 Economic Development (3 credit hours)
Examination of problems encountered in promoting regional and national economic development. Consideration given to structural changes required for raising standards of living. Some basic principles of economics applied to suggest ways of achieving development goals. Planning strategies, policies and external assistance.

Prerequisite: EC(ARE) 301 or 401
Typically offered in Spring only

ECG 548 International Economics (3 credit hours)
This course covers the determinants of international trade, migration, and investment and their connection with economic growth. It also covers macro/monetary issues, including exchange rates, financial markets and monetary-fiscal policy in open economies.

Prerequisite: EC 301
Typically offered in Spring only

ECG 561/ST 561 Applied Econometrics I (3 credit hours)
Introduction and application of econometrics methods for analyzing cross-sectional data in economics, and other social science disciplines, such as OLS, IV regressions, and simultaneous equations models. Students should have had a statistical methods course at the 300 level or above as well as Calculus I and II.

Typically offered in Fall only

ECG 562 Applied Econometrics II (3 credit hours)
This course is a continuation of Applied Econometrics I (ECG 561). After a review of probability and statistics, and simple and multiple regression models, we explore the following topics: regression using panel (longitudinal) data, instrumental variables regression, regression with a binary dependent variable, prediction with many regressors and ``Big Data'' methods, and time series regression. The emphasis is on recognizing the conditions in which it is appropriate to apply the various techniques, formulating a relevant model, estimating the model and interpreting the results. This course will also provide the students practical experience in applied econometrics using STATA.

P: ECG 561
Typically offered in Spring only

ECG 563 Applied Microeconometrics (3 credit hours)
This course will survey econometric methods for the analysis of panel and limited dependent variable data. Both the theoretical foundation and empirical application of methods will be covered. Topics include fixed and random effects, program evaluation, censored, truncated, discrete choice and count data models. Although not required, ECG 561, ST 511 or ST 512 is encouraged prior to taking this class.

Typically offered in Fall only

ECG 564 Big Data Econometrics (3 credit hours)
The goal of this course is to introduce students to a wide range of methods, which are designed to tackle commonly seen real-world problems, and are intensively used in the current literature. These methods include linear regression, logistic regression, bootstrapping, cross validation, bagging, boosting, splines, random forests, neural networks, and support vector machines. This course is application oriented. We will emphasize the intuition behind each method and touch on a little bit of theory.

P: EC 451 or ECG 561 or ST 430
Typically offered in Fall only

ECG 590 Special Economics Topics (1-6 credit hours)
Examination of current problems on a lecture-discussion basis. Course content varies as changing conditions require new approaches to deal with emerging problems.

Typically offered in Fall, Spring, and Summer

ECG 630 Independent Study (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

ECG 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ECG 700 Fundamentals of Microeconomics (3 credit hours)
Preparatory course for ECG701-702, intended for those lacking sufficient background to go directly into those courses Economic theory with extensive use of calculus. Consumer and producer optimization. Price and output determination in competitive markets, monopoly, and imperfectly competitive markets. Factor Markets. General equilibrium, externalities and public goods.

Prerequisite: MA 131 and EC(ARE)301
Typically offered in Fall only

ECG 701 Microeconomics I (3 credit hours)
Theory of consumer behavior. Primal-dual relationships in consumer theory including indirect utility functions and consumer expenditure functions. Properties of consumer demand functions. Consumer welfare measurement. Production technology and the theory of the firm including cost minimization and profit maximization. Dual relationships in producer theory including cost functions and profit functions. Properties of firm output supply and input demand equations. Long-run market equilibrium in a competitive market environment. Market equilibrium with upward sloping input supply equations. The theory of monopoly.

Prerequisite: ECG 700, MA 231
Typically offered in Fall only

ECG 702 Microeconomics II (3 credit hours)
General equilibrium. Economics of information and uncertainty. Game theory. Mechanism design and social choice. Contract theory.

Prerequisite: ECG 701
Typically offered in Spring only

ECG 703 Fundamentals of Macroeconomics (3 credit hours)
Fundamental topics in macroeconomics, including consumption, investment, government purchases, taxation, government debt, output supply, money and inflation, unemployment, elementary economic growth. Emphasis is on the microeconomic foundations of macroeconomics. Economic intuition is stressed.

Prerequisite: EC(ARE) 301,EC 302,BUS(ST)350,MA 131
Typically offered in Spring only

ECG 704 Macroeconomics I (3 credit hours)
Rigorous examination of basic macroeconomic theory, including household choice of consumption demand and labor supply, capital accumulation and economic growth, government purchases, taxation, government debt, investment, consumption and investment under uncertainty, real business cycle models. Throughout the course, the connection between economic intuition and formal mathematical analysis is emphasized. The level of mathematical rigor is high.

Prerequisite: ECG 561, ECG 703, MA 242
Typically offered in Fall only

ECG 705 Macroeconomics II (3 credit hours)
Continuation of ECG 704. Topics include, but are not limited to, money demand and supply; money and growth; inflation; term structure of interest rates; money and fluctuations, including real and New Keynesian models; theories of unemployment; conduct of policy and problems of time consistency; asset pricing; introduction to open economy models.

Prerequisite: ECG 704
Typically offered in Spring only

ECG 706 Industrial Organization (3 credit hours)
Survey of microeconomic literature on industrial organization: internal structure of the firm, number and sizes of firms in an industry, pricing and output behavior of firms. Public policy, including antitrust laws, patent and copyright laws, and government regulation of industry.

Prerequisite: ECG 700
Typically offered in Fall only

ECG 707 Topics In Industrial Organization (3 credit hours)
Advanced study of selected topics such as oligopoly theory, empirical models of industry, principal-agent contracts, economic theories of firm organization, antitrust issues, economic theories of regulation and economics of property rights.

Prerequisite: ECG 700
Typically offered in Spring only

ECG 708 Advanced Microeconomic Theory (3 credit hours)
Survey of literature on game theory focusing on applications to numerous areas of economics. Course will cover the classic literature on auctions, matching theory and non-cooperative game theory. Special focus on applying these theoretical results to practical problems of market design.

Prerequisite: ECG 702
Typically offered in Fall only

ECG 709 Behavioral and Experimental Economics (3 credit hours)
Survey of literature on behavioral and experimental economics from a broad perspective, with coverage of numerous fields of economics, including both laboratory and field experiments. Methodology of experimental economics and design of laboratory and field experiments will be covered.

Prerequisite: ECG 702
Typically offered in Spring only

ECG 715 Environmental and Resource Economics (3 credit hours)
Theoretical tools and empirical techniques necessary for understanding of resource and environmental economics, developed in both static and dynamic framework. Discussions of causes of environmental problems, possible policies and approaches to nonmarket valuation. Analysis of resource use over time using control theory for both renewable and exhaustible resources.

Prerequisite: ECG 700
Typically offered in Fall only

ECG 716 Topics In Environmental and Resource Economics (3 credit hours)
Advanced study of selected topics in environmental and resource economics. Topics vary with interests of instructor and students.

Prerequisite: ECG 715
Typically offered in Spring only

ECG 730 Labor Economics (3 credit hours)
Application of microeconomic theory and econometric methods to labor market behavior in both static and dynamic contexts. Labor demand analysis, labor force participation, hours of work, household production, human capital, distribution of earnings,information and search, and mobility.

Prerequisite: ECG 700 and one of the following: ECG(ST) 561, ST 422, ST 512, ST 708
Typically offered in Fall only

ECG 739 Empirical Methods for Development Economics and Applied Microeconomics (3 credit hours)
This course will provide an in-depth study of the application of the core tools of causal inference and microeconometrics to answer questions in development microeconomics. The class will largely consist of two activities: (1) close reading and guided discussion of seminal and recent papers and (2) the analysis of real data to estimate causal relationships. While the particular applications we study will come largely from development economics, the course is intended to be useful to students in diverse areas of applied micro.

Prerequisite: ECG 751 and ECG 753
Typically offered in Spring only

ECG 740 Economic Growth and Development (3 credit hours)
Microeconomic issues of growth. Technology adoption and the distributional effects of technical change; the role of agriculture in economic development; land tenure and tenancy arrangements; the role of agrarian institutions in the development process; and poverty, inequality and economic growth in developing countries. Approximately equal time devoted to theory and evidence.

Typically offered in Fall only

ECG 741 Agricultural Production and Supply (3 credit hours)
Advanced study in logic of, and empirical inquiry into, producer behavior and choice among combinations of factors and kinds and qualities of output; aggregative consequences of individuals' and firms' decisions in terms of product supply and factordemand; factor markets and income distribution; and general interdependency among economic variables.

Prerequisite: ECG 700
Typically offered in Fall only

ECG 742 Consumption, Demand and Market Interdependency (3 credit hours)
Analysis of behavior of individual households and of consumers in aggregate with respect to consumption of agricultural products; impact of these decisions on demand for agricultural resources, competition among agricultural regions and for markets;and interdependence between agriculture and other sectors of the economy.

Prerequisite: ECG 700
Typically offered in Spring only

ECG 748 Theory Of International Trade (3 credit hours)
Consideration of specialized body of economic theory dealing with international movement of goods, services, capital and payments. A theoretically oriented consideration of policy.

Prerequisite: ECG 700, 703
Typically offered in Spring only

ECG 749 Monetary Aspects Of International Trade (3 credit hours)
Macroeconomic problems of an open economy including balance of payments adjustment mechanism, alternative exchange rate systems, external effects of monetary and fiscal policy, optimum currency areas and international monetary reform.

Prerequisite: ECG 703
Typically offered in Fall only

ECG 750/ST 750 Introduction to Econometric Methods (3 credit hours)
Introduction to principles of estimation of linear regression models, such as ordinary least squares and generalized least squares. Extensions to time series and panel data. Consideration of endogeneity and instrumental variables estimation. Limited dependent variable and sample selection models. Attention to implementation of econometric methods using a statistical package and microeconomic and macroeconomic data sets.

Prerequisite: ST 421; Corequisite: ST 422
Typically offered in Spring only

ECG 751/ST 751 Econometric Methods (3 credit hours)
Introduction to important econometric methods of estimation such as Least Squares, instrumentatl Variables, Maximum Likelihood, and Generalized Method of Moments and their application to the estimation of linear models for cross-sectional ecomomic data. Discussion of important concepts in the asymptotic statistical analysis of vector process with application to the inference procedures based on the aforementioned estimation methods.

Prerequisite: ST 421, ST 422
Typically offered in Fall only

ECG 752/ST 752 Time Series Econometrics (3 credit hours)
The characteristics of macroeconomic and financial time series data. Discussion of stationarity and non-stationarity as they relate to economic time series. Linear models for stationary economic time series: autoregressive moving average (ARMA) models; vector autoregressive (VAR) models. Linear models for nonstationary data: deterministic and stochastic trends; cointegration. Methods for capturing volatility of financial time series such as autoregressive conditional heteroscedasticity (ARCH) models. Generalized Method of Moments estimation of nonlinear dynamic models.

Prerequisite: ECG(ST) 751
Typically offered in Spring only

ECG 753/ST 753 Microeconometrics (3 credit hours)
The characteristics of microeconomic data. Limited dependent variable models for cross-sectional microeconomic data: logit/probit models; tobit models; methods for accounting for sample selection; count data models; duration analysis; non-parametricmethods. Panel data models: balanced and unbalanced panels; fixed and random effects; dynamic panel data models; limited dependent variables and panel data analysis.

Prerequisite: ECG 751
Typically offered in Spring only

ECG 765 Mathematical Methods For Economics (3 credit hours)
Linear algebra and matrices, optimization with equality and inequality constraints, comparative statistics, differential and difference equations, intertemporal optimization. Economic applications to utility and profit maximization, national income determination, economic growth, business cycles.

Prerequisite: MA 231 , introductory course in linear algebra
Typically offered in Fall only

ECG 766 Computational Methods in Economics and Finance (3 credit hours)
Fundamental methods for forumlating and solving economic models numerically will be developed. Emphasis on defining the mathematical structure of problems and practical computer methods for obtaining model solutions. Major topics include solution of systems of equations, complementarity relationships and optimization. Finite and infinite dimensional problems will be addressed, the latter through the use of finite dimensional approximation techniques. Particular emphasis placed on solving dynamic asset pricing, optimization and equilibrium problems. MS in Financial Mathematics Program required.

Prerequisite: (MA 305 or MA 405) and MA 341 and EC 301 and EC 302 and (CSC 112 or 114) or equivalents.
Typically offered in Fall only

ECG 784 Advanced Macroeconomics (3 credit hours)
Advanced study of macro-economics. Emphasis on business cycles and behavior of real variables. Real, incomplete information and disequilibrium theories of the business cycle; rational expectations; contract theory and indexation; investment; and effects of government expenditure, taxes and debt.

Prerequisite: ECG 704
Typically offered in Spring only

ECG 785 Monetary Economics (3 credit hours)
Field course for students desiring a specialization in monetary economics or macroeconomics. Survey of current topics in monetary theory and policy.

Prerequisite: ECG 705
Typically offered in Spring only

ECG 790 Avanced Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

ECG 830 Independent Study (1-3 credit hours)
Typically offered in Fall and Summer

ECG 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Graphic Communications (GC)

GC 120 Foundations of Graphics (3 credit hours)
Introductory course providing orientation to language of graphics for students majoring in any field. Designed to help develop ability to use CAD within the context of a concurrent design process to understand how everyday objects are designed, analyzed and created. Emphasis placed on decision-making processes involved with creating geometry and development of modeling strategies that incorporate intentions of designer.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

GC 250 Architectural Graphic Communications (3 credit hours)
Architectural Graphic Communications is an advanced graphic course designed to expand on the concepts covered in the introductory courses (GC 120, GC 210, GC 211). The emphasis is on strengthening architectural sketching and CAD drawing skills and showing how specific construction processes and materials selected for an architectural design affect commercial and residential production architectural drawings. Topics include perspectice drawing, shadow projection, texturization, rendered plans,elevations and other related topics.

Prerequisite: GC 120 or TDE 220
Typically offered in Fall and Spring

GC 320 3D Spatial Relations (3 credit hours)
Analysis and solution of three-dimensional space problems utilizing graphic principles of orthogonal projection techniques. Application of studies of lines; surfaces; solids; surface intersections; surface development; vectors; and civil, mechanical, and geographical structures.

Prerequisite: GC 120
GEP Mathematical Sciences
Typically offered in Fall and Spring

GC 330 Basic Technical Animation (3 credit hours)
Create technical animations to communicate scientific and technical information to a variety of audiences and environments. Includes performing basic skills in image processing including cropping, transformations, color manipulation and color enhancement. Students will apply basic concepts of constructing 3-D objects, spaces, and environments. Create technical animations which apply environmental attributes including surface study, texture, color, lighting models, photo-realism, and raytracing.

Prerequisite: GC 120 or TDE 220
Typically offered in Fall only

GC 340 Concepts of Website Development (3 credit hours)
An introduction to the essential elements of web site development for students in Technology Education and Graphic Communications. Content focuses on planning and executing web site for educational effectiveness, user interfaces, site testing, and maintenance. Course provides instruction in software appropriate for creating a website.

Typically offered in Summer only

GC 350 Applied CAD/D and Geometric Controls (3 credit hours)
Techniques for producing mid-level computer models of individual parts and assemblies of parts. Application of conventional tolerancing and geometric tolerancing and dimensioning. Investigation of design for manufacture and CAD/CAM (Computer-AidedDesign/Computer-Aided Manufacture) processes. Conventions and standards for technical drawing documentation.

Prerequisite: GC 120
Typically offered in Fall and Spring

GC 420 Visual Thinking (3 credit hours)
Develop visual thinking skills through a series of exercises using various visual media. Integrates and stresses drawing and construction activities essential to visual thinking. Emphasis on direct observation (seeing), mental imagery and sketching that is based upon three-dimensional space. Develops students' visual and drawing skills and provides for their application toward solving open-ended spatial problems. Intended for the scientific and technically oriented student.

Typically offered in Fall and Spring

GC 450 Advanced Graphics Usage with CAD (3 credit hours)
Advanced applications of 3-dimensional solid modeling tools in technical and engineering environments. Theory and application of manufacturing databases developed with 3-D modeling tools. Development and management of 3-D geometry using modeling software. Emphasis on application of 3-D modeling technology.

Prerequisite: GC 350 -- Applied CAD/D and Geometric Controls
Typically offered in Fall and Spring

GC 496 Special Topics in Graphic Communications (1-4 credit hours)
Topical study in areas of current interest and need to students and/or needs of curricula served by Graphic Communications.

Typically offered in Fall, Spring, and Summer

GC 498 Independent Study in Graphic Communications (1-4 credit hours)
Independent study in areas of current interests and needs of students in the field of Graphic Communications and the visual sciences. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: GC 120 or TDE 220
Typically offered in Fall, Spring, and Summer

Graphic Design (GD)

GD 201 Design, Context, and Experience (6 credit hours)
Introduction to analysis and form-making in graphic design through investigations of design artifacts as components of larger and physical, social, cultural, and technological systems. Appropriate student-owned technology and software required. Graphic Design Majors Only, except with Department Head permission

Prerequisite: GD 210 Co-requisite: GD 217
Typically offered in Fall only

GD 202 Designing for Settings, People, and Use (6 credit hours)
Relationships among audience/user interpretive behavior, attributes of physical and cultural settings, and objects with attention to different perspectives on the role of the designer. Graphic Design Majors Only, except with Department Head permission.

Prerequisite: GD 201, GD 217; Corequisite: GD 317
Typically offered in Spring only

GD 203 History of Graphic Design (3 credit hours)
Events, ideas, movements, designs and individuals that have historical significance and influence on contemporary graphic design and the graphic design profession. Concentration on graphic design of the last 100 years.

GEP Visual and Performing Arts
Typically offered in Spring only

GD 210 Image and Tech Tinkering (6 credit hours)
GD 210 is an introduction to exploration with imagery and technology. It introduces basic critical and interpretative ideas about images in context and with users in mind. This includes fundamentals of both the reproduction and experience of imagery that are particularly relevant to the Graphic Design curriculum. GD 210 also introduces students to technologies relevant to current and future design practice, and nurtures rapid ideation through prototyping techniques. Graphic Design majors only, except with Department Head permission.

Prerequisite: D 104
Typically offered in Spring only

GD 217 Typography and Technology (3 credit hours)
Introduction to typography with respect to four primary systems: reading, form, language, and technology. Appropriate student-owned technology and software required. Graphic Design majors only, except with Department Head permission.

Prerequisite: GD 210
Typically offered in Fall only

GD 301 Branding, Interaction, and Service Design (6 credit hours)
Investigations of branding, interaction, and service design in response to problems of complex systems and contexts. Graphic Design majors only, except with Department Head permission.

Prerequisite: GD 202. Corequisite: GD 417
Typically offered in Fall only

GD 303 Graphic Design Theory and Practice (3 credit hours)
An examination of theories and critical perspectives shaping graphic practice. The course includes a discussion of contemporary design strategy in business and the role of visual communication in the information age.

GEP Visual and Performing Arts
Typically offered in Fall only

GD 310 Visualization, Representation, and Display (3 credit hours)
Surveying, documenting, and interpreting sites and subjects; representing relationships among settings, people, and objects through image-making strategies, such as activity maps, interviews, panoramas, and visual essays. Graphic Design majors only, except with Department Head permission for other college of design majors.

Prerequisite: GD 210
Typically offered in Spring only

GD 317 Typographic Language, Writing, and Reading (3 credit hours)
Continuation of typography and technology with greater emphasis on the individual reading experience, including page sequencing, grids, and the relationship between historical conventions and new interpretive demands on readers. Graphic Design majors only, except with Department Head permission.

Prerequisite: GD 217
Typically offered in Spring only

GD 400 Advanced Graphic Design Studio (6 credit hours)
Topical and interdisciplinary studios addressing advanced visual communication problems. Graphic Design Majors only, except with Department Head permission.

Prerequisites: GD 301 and GD 203 and GD 303
Typically offered in Fall and Spring

GD 401 Graphic Design Practicum (3 credit hours)
Capstone experience focused on the transition from school to career. Individual capstone project and discussions of professional practice, guidelines, and ethics. Graphic Design majors only, seniors.

Prerequisite: GD 301 and GD 410 and GD 417
Typically offered in Fall only

GD 410 Online and Mobile Interaction Design Systems (3 credit hours)
Exploration of dynamic communication systems, including methods for visualizing user interaction, setting conditions for user experience, and managing collaborative work. Graphic Design majors only, except with Department Head permission for other College of Design majors.

Prerequisite: GD 310
Typically offered in Fall only

GD 417 Information and Publishing Design Systems (3 credit hours)
Continuation of typographic language, writing, and reading with attention to advanced grid, form, and font systems in the design of multi-page documents, as well as issues of production and printing. Graphic Design majors only, except with Department Head permission.

Prerequisite: GD 317
Typically offered in Fall only

GD 490 Graphic Design International Studio (6 credit hours)
Define visual communication design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary visual communication. Directed studies in history and culture, and in artifact making. Additional travel and trip costs are required beyond registration fees, as well as appropriate immunizations.Graphic Design majors and departmental approved Elective ("swing") Studio for all other College of Design Majors with Junior or Graduate Standing in Major.

Prerequisite: Junior standing in the major and Study Abroad Office approval
Typically offered in Summer only

GD 492 Special Topics in Graphic Design (3 credit hours)
Topics of current interest in Graphic Design. Normally used to develop new courses. Graphic Design Majors, and department approved elective for all other college of Design Majors with Junior or Graduate standing in major.

Prerequisite: Jr standing in Graphic Design major
Typically offered in Fall, Spring, and Summer

GD 494 Internship in Graphic Design (3 credit hours)
Supervised field experience in graphic design offices and organizations. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

GD 495 Independent Study in Graphic Design (1-3 credit hours)
Special projects in graphic design developed under the direction of a faculty member on a tutorial basis. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in Graphic Design and 3.0 GPA or better
Typically offered in Fall, Spring, and Summer

GD 501 Graduate Graphic Design Studio (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 571 faculty. Center of framework on role of design objects as cognitive artifacts and extension, transformation or diminishment of human thought by their form and content. Interaction of potential audiences with designer-created artifacts. Graphic design majors only.

Corequisite: GD 571
Typically offered in Fall only

GD 502 Graduate Graphic Design Studio II (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 572 faculty. Center of framework on role of design objects as cultural artifacts and their reflection on social diversity of both designers and audiences. Creation, reproduction, distribution and reception of messages in both designer-created artifacts and audience's response. Graphic design majors only.

Prerequisite: GD 501, Corequisite: GD 572
Typically offered in Fall only

GD 503 Graduate Graphic Design Studio III (9 credit hours)
Student-defined graphic design projects in response to critical content framework presentation by GD 671 faculty. Center of framework on nature of new information environments. Shape and response of technologies to new cognitive and cultural relationships among audiences.

Prerequisite: GD 573, Corequisite: GD 671
Typically offered in Spring only

GD 510 Imaging for Graphic Design IV (3 credit hours)
Advanced problems in the visual design and structuring of information in interactive multimedia presentations. Topics include the design of interfaces, navigation, motion graphics, and websites as well as exploration of narrative and hypermedia approaches to the organization of content.

Prerequisite: GD 410, Design Majors
Typically offered in Spring only

GD 517 Type IV (3 credit hours)
Advanced problems of typographic expression/communication in which typographic variables are used to alter, enhance, or reinforce verbal meaning. Historic precedent and experimentation with the conventions for typographic form are explored. The impact of the computer on changes in typographic aesthetics, including motion graphics, typeface design, and website design.

Prerequisite: GD 417, Design Majors
Typically offered in Spring only

GD 571 Design As Cognitive Artifact (3 credit hours)
Relationship between theories of human cognition and graphic design. Analysis and critique of design objects as cognitive artifacts and extension, transformation or diminishment of human thought by their form and content. A critical examination of cognitive, linguistic and social science theories shaping graphic design. Non-majors by permission only.

Typically offered in Spring only

GD 572 Design as Cultural Artifact (3 credit hours)
Introduction to recent theories in various disciplines concerning a cultural understanding of graphic design. Theories of mass and popular culture, critiques of creativity and authorial intentionality, influences of interpretive criticism, theories of consumption and issues of cultural representation. Emphasis on adaptation of these theories to an understanding of the cultural significance of graphic design. Non-majors by permission only.

Typically offered in Fall and Spring

GD 573 New Information Environments (3 credit hours)
Changing role of graphic design in new information environments. Implications of new technology on social construction of meaning, impact of electronic media on culture and cognition, and differences in designing artifacts and designing experiences.Non-majors by permission only.

Prerequisite: GD 503
Typically offered in Spring only

GD 580 Special Topics In Graphic Design History (1-6 credit hours)
Topics of current interest in interpretation, criticism, methodology and research, relating to graphic design history. Further specialized study in history of printing, typography, communication, image-making and information systems. Investigation of how we study artifacts, production and producers.

Prerequisite: GD 242
Typically offered in Spring only

GD 581 Graphic Design Final Project Research (3 credit hours)
A seminar course to assist students in preparing foundation for final project to be conducted in GD 688 Final Project Studio.

Prerequisite: GD 502
Typically offered in Fall only

GD 588 Final Project Studio In Graphic Design (6 credit hours)
Final project for graduate students supervised by members of their graduate advisory committees.

Prerequisite: GD 581
Typically offered in Spring only

GD 592 Special Topics In Graphic Design (1-6 credit hours)
Topics of current interest to program/option offered by faculty in School. Subjects offered under this number normally used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall only

GD 610 Special Topics In Graphic Design (1-6 credit hours)
An investigation of special topics in graphic design of a particular interest to advanced students under direction of chair of graduate committee on a tutorial basis; credit and content vary with each student.

Prerequisite: Permission of grad. advisor
Typically offered in Fall and Spring

GD 630 Independent Study In Graphic Design (1-3 credit hours)
Special problems in various aspects of graphic design developed under the direction of a faculty member on a tutorial basis.

Typically offered in Fall, Spring, and Summer

GD 676 Special Project In Graphic Design (1-3 credit hours)
Seminar on subjects of current interest in graphic design, presented by persons not part of regular faculty.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

GD 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

GD 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

GD 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

GD 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Health and Exercise Studies Minor (HESM)

HESM 201 Coaching Baseball/Softball (2 credit hours)
Theories, techniques, and strategies of coaching baseball/softball.

HESM 202 Coaching Basketball (2 credit hours)
Theories, techniques, and strategies of coaching basketball.

Typically offered in Fall, Spring, and Summer

HESM 203 Coaching Football (2 credit hours)
Theories, techniques, and strategies of coaching football.

Typically offered in Fall and Spring

HESM 204 Coaching Golf (2 credit hours)
Theories, techniques, and strategies of coaching golf.

Typically offered in Fall, Spring, and Summer

HESM 205 Coaching Soccer (2 credit hours)
Theories, techniques, and strategies of coaching soccer.

HESM 207 Coaching Tennis (2 credit hours)
Theories, techniques, and strategies of coaching tennis.

HESM 209 Coaching Volleyball (2 credit hours)
Theories, techniques, and strategies of coaching volleyball.

Typically offered in Fall only

HESM 211 Strength Training and Conditioning (2 credit hours)
Knowledge and skills necessary for designing and implementing strength and conditioning programs. This course does not constitute credit toward meeting the minimum university Physical Education requirements

Typically offered in Fall and Spring

HESM 212 Alcohol, Drugs and Tobacco (2 credit hours)
Theories of drug use, pharmacology, tolerance, dependence, nicotine, alcohol usage, alcoholism, sedative-hypnotics, narcotics, amphetamines, cocaine, marijuana, hallucinogens, steroids and treatment. This course does not constitute credit toward meeting the Physical Education GER requirement

Typically offered in Fall, Spring, and Summer

HESM 213 Human Sexuality (2 credit hours)
Physiological and psychosocial aspects of human sexuality. Emphasis placed on health-related topics of birth control, pregnancy, childbirth, abortion and sexually-transmitted diseases. Concepts of gender acquisition, sexual values, and sexual morality discussed as related to the promotion of healthy lifestyles within contemporary American culture.

HESM 214/PRT 214 Foundations in Outdoor Leadership and Adventure Education (3 credit hours)
Foundations in outdoor leadership and adventure education topics include outdoor education history, group development models, experiential education theories, leadership styles and facilitation, risk management for groups, expedition and trip planning, employment opportunities, current trends and issues, environmental stewardship, assessment and evaluation.

Typically offered in Spring only

HESM 275 Behavior Change in Wellness (2 credit hours)
This course introduces students to the eight dimensions of wellness (social, physical, emotional, occupational, intellectual, environmental, spiritual, financial) and features a series of lectures, in-class activities and discussions, course readings, and personal wellness profile, co-curricular wellness activities, and a behavior change project. Wood Wellness Village first time residents; This course does not fulfill the health and exercise studies GEP requirement.

Restricted to: Wood Wellness Village Students only
Typically offered in Fall only

HESM 280 Responding to Emergencies (2 credit hours)
This course introduces the basics of first aid treatment for the lay rescuer. Topics include CPR, AED use, chocking and bleeding emergencies, and other basic first aid procedures. This course does not satisfy the Physical Education GEP requirement.

Typically offered in Fall, Spring, and Summer

HESM 284 Women's Health Issues (2 credit hours)
This course will review health and wellness issues affecting women through their life span. It will explore medical concerns and prevention as well as social health issues that disproportionately affect women in contemporary society. Discussions of current critical topics in women's health will also take place. Minor courses.

Typically offered in Fall, Spring, and Summer

HESM 285 Personal Health (2 credit hours)
Behavior change, wellness, stress management, cardiovascular diseases, alcohol and tobacco use, cancer, infectious diseases, arthritis, human sexual response, sexual assault, contraception, and sexually transmitted diseases. This course does not constitute credit toward meeting the Physical Education GER requirement

Typically offered in Fall, Spring, and Summer

HESM 286 Nutrition, Exercise and Weight Control (2 credit hours)
A nutrition, exercise and weight management program emphasizing the basics of proper nutrition and exercise. Emphasis on lifestyle changes and their relationship to appropriate weight management. Medical request

Typically offered in Fall, Spring, and Summer

HESM 287 Stress Management (2 credit hours)
Impact of stress upon the psychological and physiological function of the body. Exploration and interaction with stress management techniques. This course does not constitute credit toward meeting the Physical Education GER requirement

Typically offered in Spring only

HESM 300 Practicum in Health (1 credit hours)
This course focuses on applying program development, management, evaluation, and educational strategies and techniques within a health-related setting. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: HESM 285, HESM 375, HESM 377, and 6 hours of electives from the Health Minor
Typically offered in Fall, Spring, and Summer

HESM 301 Coaching Practicum (1 credit hours)
A 30-hour practical coaching experience in a middle school or high school setting. Specific placement will depend upon the various playing sessions for the sports involved. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: Requires departmental consent, First Aid, and CPR Certification or Equivalent
Typically offered in Fall, Spring, and Summer

HESM 303 Sports Science Practicum (1 credit hours)
A 30-hour practical sports science specialist experience in a fitness specific setting within the triangle area. Course does not constitute credit toward meeting the physical education requirement. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: Completed coursework in Sports Science Minor
Typically offered in Fall, Spring, and Summer

HESM 315 Challenge Course and Team Building Facilitation (3 credit hours)
Participants will learn the theory and practical skills necessary to facilitate and operate team building activities and high ropes challenge courses. Students will facilitate group initiatives, low course elements, zip lines and high course elements. Safety, risk management, programming, facilitation and debriefing techniques are presented and discussed in detail. Participate in one weekend of low elements and high course element training. Additional charge assessed for the field trip.

Typically offered in Spring only

HESM 316 Outdoor Education Pedagogy (3 credit hours)
Techniques for teaching outdoor skills and activities are covered including teaching and learning styles, lesson planning, classroom management and risk management. Emphasis is placed on presentations of skills instruction for outdoor educators. Students will make numerous outdoor activity skills presentations, including a student-led group presentation. Students will also evaluate and provide feedback for classmates. Students must participate in two required weekend field trips and a one-day group project at the NC State instructional climbing center. Additional charge assessed for the field trips. Refer to the online schedule of classes for the current charge and dates.

P: Two of the three courses: HESO 255, HESO 257, HESO 258
Typically offered in Fall only

HESM 324 Concert Dance History (3 credit hours)
An overview of the development of Western theatrical dance. This course introduces the major figures and movement theories of the 19th & 20th Centuries with particular emphasis on major stylistic trends and cultural influences. Readings, discussions, lectures, and films/videotapes will introduce selected choreographers and the concerns that inform their work. Additional readings in dance philosophy and aesthetics will address ideas such as form, expression, audience expectations, and performance conventions. A small fee may be required for concert attendance.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

HESM 370 Foundations of Sport Coaching and Instruction (2 credit hours)
This course will introduce methods of skill instruction, basic teaching strategies, and pedagogy in the area of sport coaching. Students will learn how to properly organize drills, plan safe and effective practices, present age-appropriate sport skills to athletes at the youth, middle and high school levels, and evaluate motor-skill development of athletes. This course will also explore psychomotor, cognitive, and affective development and performance of athletes in school and community settings. Students in this course will have the opportunity to teach cooperatively with peers and will also be presented with opportunities to teach micro-lessons in their area of sport interest.

Typically offered in Spring only

HESM 375 Health Planning and Programming (2 credit hours)
This course is designed to assist students in developing a foundation in health programming. Students will learn the necessary skills to develop, implement, and evaluate health education programs.

Prerequisite: HESM 285 Personal Health
Typically offered in Fall only

HESM 377 Methods of Health Promotion (2 credit hours)
This course focuses on methods and techniques for delivering health-related content to diverse populations. Cooperative learning, critical thinking, peer educator training, and decision-making will be applied to various health dimensions.

Typically offered in Spring only

HESM 381 Athletic Training (3 credit hours)
Incidence, causes, prevention and treatment of sports-related injuries. Conditioning for sports, injury recognition and evaluation, taping techniques, first aid care, treatment and reconditioning.

Prerequisite: HESM 280 or HESM 281 or or CPR/First aid Certification
Typically offered in Fall, Spring, and Summer

HESM 395 Special Topics in Health and Exercise Studies (1-3 credit hours)
Examination of selected topics in health, outdoor leadership, sports science, coaching, and dance. This course does not fulfill the GEP requirement for Health and Exercise Studies.

Typically offered in Fall, Spring, and Summer

HESM 402 Practicum Experience in Outdoor Programs (1 credit hours)
The practicum experience provides a short-term, supervised opportunity for students to participate in leading an outdoor activity course or program. The practicum is the integration of academic preparation with its application in a field setting. The student may be assigned to a Department of Health and Exercise Studies outdoor activity course, program or to an approved non-University program in order to meet this requirement. The practicum student must be directly involved in the program for a minimum of 30 hours. Students are required to purchase internship liability insurance to participate in the practicum; the fee is automatically charged upon registration. Contact University Insurance & Risk Management for more details.

Prerequisite: HESM 214, HESM 315, HESM 316, First aid/CPR certification or equivalent
Typically offered in Fall, Spring, and Summer

HESM 476 Motor Learning and Sport Performance (3 credit hours)
This course will introduce the concepts, principles, and theories dealing with the performance of motor skills as applied in the areas of sport performance and physical activity. Topics will discuss how skilled movements are learned, maintained, and enhanced as well as explore some of the basic physiological, bio-mechanical, and cognitive influences which affect the quality of skilled performance. This course is primarily designed to benefit sport coaches, physical educators, and fitness instructors.

Typically offered in Fall only

HESM 477 Coaching Concepts (3 credit hours)
Practical and theoretical concepts essential to the preparation of coaches. This course does not constitute credit toward meeting Physical Education requirements

Typically offered in Fall, Spring, and Summer

HESM 478 Exercise Physiology and Sports Science (3 credit hours)
Basic principles of human anatomy, physiology, and biomechanics and their relationship to athletic coaching.

Typically offered in Fall, Spring, and Summer

HESM 479 Sport Management (3 credit hours)
Planning, organizing, leading, and evaluating within a sport context; fundamentals of accounting, budgeting, economics, marketing, strategic planning, ethics, and their use in sport settings; techniques of personnel, facility, and sporting event management.

HESM 480 Principles of Exercise Programming (3 credit hours)
Fundamentals and scientific principles necessary to plan, design, implement, and evaluate individual exercise programs.

Prerequisite: HESM 478
Typically offered in Fall and Spring

Health Exercise Studies Dance (HESD)

Health Exercise Studies Fitness (HESF)

HESF 100 Cross Training (2 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility, and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobic activities as well as strength and endurance conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 101 Fitness and Wellness (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced running activities as well as strength and endurance conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 102 Fitness Walking (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced fitness walking techniques and strength conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 103 Water Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues are also addressed. The components of fitness will be met through structured individually paced water aerobics classes that will take place in chest deep water. Muscular strength activities could take place in or out of water.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 104 Swim Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. This course covers the mechanics of a variety of strokes, training methods, training principles, safety, with swim techniques that maximize fitness gains and minimize injuries.

Prerequisite: PE 215 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 105 Aerobics and Body Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobics classes. Muscular strength activities could take place in or out of the aerobics room.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 106 Triathlon (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced swim, cycle and run training techniques. The student must provide bicycles and ANSI approved helmets.

Prerequisite: PE 221 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 107 Run Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced running activities on an indoor or outdoor track, and/or a cross-country route. Muscular strength activities will occur in a weight room or incorporated during running activities.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 108 Water Step Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individual paced water step aerobics classes that will take place in chest deep water on an aquatic exercise step. Muscular strength activities could take place in our out of the water.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 109 Step Aerobics (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced step aerobics classes. Muscular strength activities could take place in or out of the aerobics room.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 110 Adapted Physical Education (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced aerobic, muscular strength and muscular endurance activities that meet the need of students with medical/physical limitations. For students with medical problems who are unable to take regular Physical Education classes. Repeatable up to two semesters.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESF 111 Indoor Group Cycling (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced indoor group cycling classes. Muscular strength activities could take place in or out of the main classroom.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 112 Fitness Kickboxing (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. Fitness kickboxing includes strikes against a heavy bag, focus mitt punching, medicine ball core exercises, running, and jumping rope. The components of fitness will be met through structured fitness kickboxing activities as well as strength and endurance conditioning exercises.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 113 High Intensity Conditioning (1 credit hours)
This course is designed to teach and apply the principles of lifetime physical fitness, utilizing the five major components of fitness: cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition. A variety of health and wellness issues will be addressed. The components of fitness will be met through structured individually paced high intensity aerobic and strength activities. High Intensity Conditioning includes plyometrics, agility drills, and running, as well as strength exercises using body weight and a variety of equipment such as dumbbells, barbells, and medicine balls. Exercises are set to various interval lengths ranging from 20-120 seconds. Use of heart rate training will be emphasized in order to differentiate between high intensity and steady state aerobic exercise.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESF 120 Movement and Meditation (1 credit hours)
This course is designed to teach and apply the principles of lifetime health-related fitness through a variety of movement activities and guided meditation practices. In this hybrid course, students meet one day per week for lectures, group discussions, and meditation practices. Students will complete two (45-minute) physical movement practices per week outside of class time, following an individualized plan to include cardio-respiratory and cardiovascular endurance, muscular strength and endurance, and mobility components. Students will design their movement plans in conjunction with the instructor during the first weeks of the course. This is an inclusive course and is suitable for students of all movement capabilities. A portion of the seats in each section will be reserved for students that have limited HESF 100-level courses options due to movement limitations. Contact the instructor for permission to enroll in a restricted seat.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

Health Exercise Studies Outdoor (HESO)

HESO 253 Orienteering (1 credit hours)
Navigating on foot from defined point to defined point, with use of map and compass in the shortest possible time.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 255 Canoeing (1 credit hours)
Instruction and experience in canoe skills; emphasizing paddling skills, safety, flat and moving water travel techniques and proper equipment selection. Plan and participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: Basic swimming ability required
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 257 Backpacking (1 credit hours)
Designed for students with little or no backpacking experience. Safe and environmentally-sound camping practices. Equipment/clothing, first aid and safety management agencies, land navigation, and trip planning. Plan and participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to online schedule of classes for the current charge.

Prerequisite: Must pass basic fitness test
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 258 Rock Climbing 1 (1 credit hours)
Instruction and direct experience for the beginning rock climber. Emphasis on safe rope systems for belaying and climbing movement on rock.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESO 259 Rock Climbing 2 (1 credit hours)
Development of gym to crag rock climbing skills and practices including: climbing safety, belaying techniques, anchor systems, partner and self-rescue, rappelling and ascending techniques, minimal impact climbing, and climbing hazards. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: HESO 258
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 262 Whitewater Canoeing (1 credit hours)
Instruction and skill development of fundamental whitewater canoeing skills. Paddling strokes and maneuvers for use on whitewater, river safety, basic river rescue, equipment selection and care, and environmental ethics. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to the online schedule of classes for the current charge.

Prerequisite: HESO 255, Intermediate swimming ability required
GEP Health and Exercise Studies
Typically offered in Fall only

HESO 263 Whitewater Kayaking (1 credit hours)
This class is designed for students with little or no whitewater kayaking experience to develop basic kayaking skills and help them become proficient paddlers. Topics will include whitewater safety, equipment use and care, paddle strokes and river running techniques, basic rescue techniques, kayak navigation, basic hydrology, and trip planning. Participate in one required weekend field trip. Additional charge assessed for the field trip. Refer to the online schedule of classes for the current charge. Students must pass swim test to participate in course.

Prerequisite: Intermediate swimming ability
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 276 Whitewater Rafting (1 credit hours)
Whitewater rafting skills and practices emphasizing safe river travel, minimal impact river camping techniques, and trip planning. Participate in one required weekend fieldtrip. Additional charge assessed for the fieldtrip. Refer to PackTracks for the current charge.

Prerequisite: Intermediate swimming ability required
GEP Health and Exercise Studies
Typically offered in Spring only

HESO 277 Mountain Biking (1 credit hours)
Bike handling, minimal impact trail riding skills, safety, fitness, basic maintenance and repair, and equipment selection. Students must provide their own bike, helmet, protective equipment, and clothing.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 278 Fly-Fishing (1 credit hours)
Instruction and experience in basic fly-fishing skills. Emphasis on casting techniques, tackle selection, habitat evaluation, minimal impact travel, safety, fitness, equipment selection and trip planning. Basic swimming ability and field trip required. Transportation provided by the Physical Education Department. Charge required with a non-refundable deposit.

Prerequisite: Basic swimming ability
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESO 283 Mountaineering (2 credit hours)
Instruction and experience in alpine climbing skills emphasizing snow and ice travel, safety, land navigation, winter hazard evaluation, minimal impact camping skills, and equipment selection. Several classroom sessions will be conducted prior to the trip. Plan and participate in a ten-day field trip over spring break. Additional charge assessed for the field trip with a non-refundable deposit. Refer to the online schedule of classes for the current charge.

Prerequisite: HESO 258, HESO 257
GEP Health and Exercise Studies
Typically offered in Spring only

HESO 284 Sea Kayaking (1 credit hours)
Instruction and experience in basic sea kayaking skills. Emphasis on paddling techniques, open water travel, navigation, minimal impact camping, safety, fitness, equipment selection and trip planning. Plan and participate in one required field trip.Additional charge assessed for the field trip with a non-refundable deposit. Refer to the online schedule of classes for the current charge.

Prerequisite: Intermediate swimming ability
GEP Health and Exercise Studies
Typically offered in Fall and Spring

Health Exercise Studies Racquet (HESR)

HESR 242 Badminton (1 credit hours)
This is a beginning badminton course in which students will develop the basic skills necessary to play the game of badminton. Technical skills include the overhead and underhand clears, the short and long serves, drop shots and the smash. Instruction will include an emphasis on the fundamental strategies and rules used in both singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of badminton.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 249 Tennis I (1 credit hours)
This is a beginning tennis course in which students will develop the basic skills necessary to play the game of tennis. Technical skills include forehand and backhand ground strokes, volleys, serves and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of tennis.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 250 Tennis II (1 credit hours)
This course will review some of the basic tennis skills introduced in the PE 249 Tennis I course. Additionally, this course will introduce more advanced techniques in stroke production and skill development such as the topspin and slice serves, approach shots, half-volleys, and drop shots. Students will analyze some of the various styles of play used in the game of tennis and perform drills as well as match play situations that will improve performance based on offensive and defensive tactics in both singles and doubles.

Prerequisite: HESR 249
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 255 Pickleball (1 credit hours)
This is a beginning pickleball course in which students will develop the basic skills to play the game of pickleball. Technical skills include forehand and backhand groundstrokes, volleys, serves, lobs, overheads, dink shots, and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of pickleball.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESR 256 Racquetball (1 credit hours)
This is a beginning racquetball course in which the students will develop the basic skills to play the game of racquetball. Technical skills include forehand and backhand groundstrokes, ceiling balls, serves and proper footwork. Students will also learn the fundamental rules, basic strategies, and court positioning for singles, cuttthroat and doubles play. Basic fitness and training principles will be discussed as applicable to the sport of racquetball. Approved protective eyewear must be provided by the student.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

Health Exercise Studies Specialty (HESS)

HESS 219 Gymnastics (1 credit hours)
Develop basic gymnastics skills on vault, bars, beam, floor, and trampoline. 1) To assist the students in safely learning progressions on each of these events for skill development. 2) To acquire the fitness requirements associated with learning these skills. 3) To identify the hazards and risks associated with gymnastics and 4) To identify basic skills and terminology associated with the sport.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESS 235 Beginning Karate (1 credit hours)
Introduction to traditional Japanese karate: kihon (basic punching, striking, blocking, and kicking techniques); kata (formal drills); yakusoku kumite (pre-arranged sparring); and demonstration of ji-yu-kumite (controlled free sparring). Karate uniform required.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESS 237 Weight Training (1 credit hours)
This is an introductory weight training course in which students will learn the principles of muscular development, as well as development of overall fitness. Free weights, machines, exercise equipment, and body weight exercises will be used to apply these principles. Various training systems and protocols will be introduced along with content of muscular physiological adaptations.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESS 239 Self Defense (1 credit hours)
Basic self defense and techniques. Skills covered include strikes, blocks, and escapes; plus psychology of general and sexual assault. Physical contact will occur between students and with the instructor as well.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESS 243 Bowling (1 credit hours)
This is a beginning bowling course in which the students will develop the basic skills necessary to play and enjoy the game of bowling. Technical skills include ball rotation and delivery along with proper foot work. Students will also learn the fundamental rules, basic strategies for throwing a strike ball, general theory for converting spares, and scoring along with bowling etiquette, terminology, rules, and safety precautions. Basic fitness and training principles will be discussed as applicable to the sport of bowling. Additional fee assessed.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESS 245 Golf (1 credit hours)
This course will provide golf instruction at an introductory level. Coursework will introduce full swing fundamentals, chipping, pitching, and putting fundamentals, rules and etiquette on the golf course, and history of the game. Students will develop an appreciation for the game of golf through practice, play, and time on the golf course. There is a required charge for class meetings held at local golf courses. Refer to the online schedule of classes for the current charge. Students must provide their own transportation to the golf course.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESS 251 Target Archery (1 credit hours)
Shooting fundamentals, safety, selection, and care of equipment.

GEP Health and Exercise Studies
Typically offered in Fall, Spring, and Summer

HESS 252 Skiing/Snowboarding (1 credit hours)
Instruction and experience in the fundamentals of skiing or snowboarding. Emphasis on safety, controlled turns and stops, equipment selections, and pre-season preparation. Slope instruction held at a selected site during winter break. Additional charge assessed for trip with a non-refundable deposit. Refer to the online schedule of classes for program format options, current charges and trip dates. Students are responsible for providing their own transportation. Final grades will not post until the second week of January. In the interim, a grade of LA will be given. December graduating seniors should be aware this will delay graduation clearance and posting of degrees.

GEP Health and Exercise Studies
Typically offered in Fall only

HESS 296 Independent Study in Physical Education (1-3 credit hours)
Independent study in Physical Education will vary according to the specialized topic of interest. Credit and content determined by instructor. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Health Exercise Studies Team (HEST)

HEST 216 Soccer (1 credit hours)
Soccer with emphasis on skills development, playing strategies, and rules of the game.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HEST 261 Basketball (1 credit hours)
Offensive and defensive skills development and systems of team work. Coverage of strategies, history and rules of the sport.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HEST 265 Slow Pitch Softball (1 credit hours)
Develop basic skills, rules and strategies for playing slow pitch softball. This course provides an ideal setting for beginning through intermediate players to acquire or enhance skill sets and obtain knowledge to participate recreationally in a slow pitch softball game or league.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HEST 266 Ultimate Frisbee (1 credit hours)
Emphasis on skill development, aerobic fitness and spirit of competition. Includes flight dynamics, various throwing and catching techniques, offensive skills, defensive skills, equipment, strategies, and rules of the game.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HEST 267 Flag Football (1 credit hours)
An introduction to the skills, history, rules and strategy of flag football.

GEP Health and Exercise Studies
Typically offered in Fall only

HEST 269 Volleyball I (1 credit hours)
This course is designed to teach and apply the basic volleyball fundamentals of setting, passing, serving, spiking, court movement, and game strategy.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HEST 270 Volleyball II (1 credit hours)
This course is designed to go beyond the basic volleyball skills. Emphasis will be placed on floater, top spin, and jump serves, forearm passing, setting, back setting, strong side and weak side attacking, blocking and advance serve reception techniques.

Prerequisite: HEST 269
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA - Health Exercise Aquatics (HESA)

HESA 214 Beginning Swimming (1 credit hours)
Swimming strokes and deep water skills for the non-swimmer to survive in the water.

GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 215 Advanced Beginning Swimming (1 credit hours)
Continuation of Basic Strokes acquired in Beginning Swimming, additional new strokes, and survival skills.

Prerequisite: HESA 214 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 217 Survival Swimming (1 credit hours)
This course will provide NCSU students with the opportunity to learn water survival skills and techniques that will enhance their chances of survival if stranded in the water. Skills include drownproofing, underwater swimming, survival swim strokes, jumping from a height, clothing inflation techniques, and swimming through a simulated oil/debris field. These survival skills and techniques will help promote physical fitness and a healthy lifestyle.

Prerequisite: HESA 214 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 221 Intermediate Swimming (1 credit hours)
This course is designed to provide instruction in five basic swim strokes-front crawl (freestyle), back crawl (backstroke), breaststroke, elementary backstroke and sidestroke. Additional emphasis will be placed on increased cardiovascular fitness along with skill development in treading water, underwater swims, turns and dives.

Prerequisite: HESA 214 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 223 Lifeguard Training (2 credit hours)
This course is designed to provide entry-level lifeguard participants with the knowledge and skills prevent, recognize and respond to emergencies and to provide care for injuries and sudden illnesses until Emergency Medical Services (EMS) personnel arrive and take over. Optional fee assessed for certification.

Prerequisite: PE 221 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 226 Skin and Scuba Diving I (2 credit hours)
This course is designed for students with little or no experience, emphasizing safety and responsible skin and scuba diving techniques. Topics include the use and care of scuba equipment, diving skills, problem solving, emergency procedures, basic rescue techniques, direct and indirect effects of pressure, medical contradictions, oxygen enriched are diving, and gas management. Optional fee assessed for open-water training field trip and certification. Students must provide their own transportation for fieldtrip(s).

Prerequisite: PE 221 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 227 Skin & Scuba Diving II (2 credit hours)
This course will build on the knowledge and skills learned in Skin & Scuba Diving I with emphasis on diver rescue techniques. Coursework will require a deeper understanding of dive planning, dive physiology, gas management, and diving first aid. Coursework will also require a higher skill level relating to propulsion techniques, navigation, equipment handling, buoyancy control, search & recovery techniques, and diving first aid than is required in Skin and Scuba Diving I. Optional fee assessed for open water training fieldtrip and certification. Students must provide their own transportation for fieldtrip(s).

Prerequisite: HESA 226 or equivalent skills
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 229 Scuba Leadership (2 credit hours)
This course will provide NCSU students with the opportunity to build upon the skills learned in PE 227 and progress towards proficiency as a scuba diving leader. This course will help promote physical fitness and skill development in scuba diving, as well as an understanding of the knowledge and skills of scuba diving leadership. Participation in scuba leadership provides interested students with the opportunity to seek clarification as a scuba diving leader. Fee is assessed for required fieldtrip(s). Students must provide their own transportation for fieldtrip(s).

Prerequisite: HESA 227 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

HESA 231 Scientific Diving (3 credit hours)
This course covers the knowledge, skills, and diving experience necessary to plan and safely conduct scientific dives with regards to site selection, safety procedures, gas mix considerations, equipment requirements, data collection techniques, and dive team selection. These skills and techniques will help promote physical fitness and a healthy lifestyle. Successful completion of all phases of the course will qualify students for certification as a "scientific diver." This course meets American Academy of Underwater Sciences (AAUS) guidelines. Fee is assessed for required fieldtrip(s). Students must provide their own transportation for fieldtrip(s).

Prerequisite: HESA 227 or equivalent skill
GEP Health and Exercise Studies
Typically offered in Fall and Spring

History (HI)

HI 205 Western Civilization Since 1400 (3 credit hours)
A survey of Western Civilization from the Renaissance to the present.

Typically offered in Fall and Spring

HI 207 Ancient Mediterranean World (3 credit hours)
The ancient cultures of the Middle East, Greece and Rome, including Mesopotamian, Egyptian, Hebrew, Phoenician, Greek and Roman societies and cultures.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 208 The Middle Ages (3 credit hours)
Medieval civilization as it emerged from the declining Roman Empire through its apogee in the 13th century. The transition from the classical to the medieval world, the impact of the Germanic influx, the Islamic influence, the Crusades, and the political, economic, and social institutions of the High Middle Ages.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 209 From Renaissance to Revolution: The Origins of Modern Europe (3 credit hours)
Exploration of the political, economic, social, and cultural history of Western Europe during an intense and exciting period of transition from a medieval to a modern world. Topics to be discussed include Renaissance art and philosophy; the printing revolution and the French Revolution; climate change and economic dislocation; witchcraze; religious reforms and religious wars; commercialization; navigation; empire; slavery; the new science; and new ideas about democracy, equality, and modernity.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 210 Modern Europe 1815-Present (3 credit hours)
Survey of the history of European societies and political systems from 1815 to the present.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 214 History and Archaeology of Ancient Latin America (3 credit hours)
Exploration of ancient Latin American civilizations and early Europeans in the region through archaeological and historical analysis. Major themes include migrations of people into the Western hemisphere, the rise and decline of states and empires such as the Maya, Aztecs, Moche, and Incas, inter-regional trade, development of writing and communication systems, religious ideology, social and political infrastructure and mechanisms of control. Unique cultural forms discussed include mummies, pyramids, military techniques, political propaganda, and agricultural innovation. Contemporary issues addressed include media representations of the past, indigenous rights, and looting and destruction of cultural property.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 215 Colonial Latin America (3 credit hours)
Exploration of the pre-Hispanic indigenous roots and the colonial period in Latin America. Major themes include the origins and development of social, political, economic and religious institutions from pre-conquest times to the achievement of independence. Topics include ancient American cultures, conquest and settlement by Spain and Portugal, colonial rule in theory and practice, religious life and structures, the colonial economy and labor, and independence movements.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 216 Modern Latin America (3 credit hours)
Analysis of the last two centuries of social, political, economic, and intellectual life in Latin America and the Caribbean. Course readings include primary sources, declassified CIA documents, and Latin American literature. Course themes include social and political conflicts, changing gender relations, human rights abuses, the effect of the US and global economic forces, and the impact of the growing Latino population in the U.S.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 217 Caribbean History (3 credit hours)
Exploration of the social, economic, political, intellectual, and cultural histories of the Caribbean. Major course topics include pre-Columbian indigeneity, colonization & imperialism, plantation slavery, abolition & emancipation, the Haitian and Cuban Revolutions, gender & migration, and decolonization & independence. The course emphasizes the diversity of the region and places the islands of the Caribbean within the wider context of a modern globalizing world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 221 British History to 1688 (3 credit hours)
History of the British peoples from earliest times to the Glorious Revolution. Social, political, constitutional developments; relationship between history and literature; synthesis of British cultures.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 222 History of British Cultures and Societies From 1688 (3 credit hours)
British people from Glorious Revolution to the present. Social, political, constitutional development; history and literature; growth and decline of British empire; spread of British culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 232 The World from 1200 to 1750 (3 credit hours)
The making of the modern world through interregional conquest and commerce from 1200 to 1750. Focus on the growing global circulation of peoples, pathogens, goods, and ideas.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 233 The World Since 1750 (3 credit hours)
This course surveys the making of the world from 1750 to the present. Topics include: the Industrial Revolution, the development of the Nation-States, the rise of European, American and Japanese Empires, WWI, inter-war reconfigurations of colonial empires, anti-colonial nationalist movements, the Great Depression, the Cold War, struggles for political and economic independence among newly independent nations, the US-dominated neo-liberal order from the 1980s to the present, and contemporary global conflicts over ethnicity, religion, resources, disease, and the environment.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 240/HA 240 Introduction to Visual Culture (3 credit hours)
Introduction to the role of visual cultural production in the nineteenth and twentieth centuries in expressing and shaping both individual and collective identities. Case studies of imperialism, gender, and war draw from different regional histories and utilize a variety of visual genres - such as photography, popular posters, painting, advertising, and film stills - to study how visual culture can be used as evidence to understand the past, using the approaches of the disciplines of History and Art History.

Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 251 American History I (3 credit hours)
Themes in early American history: colonial clash and mix of cultures; generation of an American consciousness; federalism and democracy in national politics; expansion and immigration; racial and sectional division. Credit is not allowed for both HI 251 and HI 253.

GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 252 American History II (3 credit hours)
Themes in post-Civil War American history: impact of war on American foreign and domestic policy; the repercussions of industrialization and economic modernization; continuity and change in American institutions and values; problem solving in pluralistic society. Credit is not allowed for both HI 252 and HI 254.

GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 253 Early American History (3 credit hours)
Themes in early American history with an emphasis on diversity in the U.S.; focus on colonial clash and mix of cultures, generation of an American consciousness, federalism and democracy in national politics, expansion and immigration, and racial and sectional division. Credit is not allowed for both HI 253 and HI 251.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

HI 254 Modern American History (3 credit hours)
Major themes in modern American history with an emphasis on diversity in the United States; focuses on aspects of race/ethnicity, gender, class, sexual orientation, disability, religious and/or age identities as it considers the impacts of industrialization and economic modernization; impact of war on American domestic and foreign policy; continuity and change in American institutions and values; problem solving in a pluralistic society. Credit is not allowed for both HI 254 and HI 252.

X: Credit not allowed for both HI 254 and HI 252.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

HI 263 Asian Civilizations to 1800 (3 credit hours)
The history of China, India, Japan, and Southeast Asia from 500 to 1800. The making of the Asian region through the rise and fall of five great empires: the Tang, the Mongol, the Mughal, the Qing, and the British empires.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 264 Modern Asia: 1800 to Present (3 credit hours)
Introductory survey of 19th and 20th century Asia, with attention to Japan, Southeast Asia, India and China. Emphasis on cultural and political crises of the 19th century and revolutionary transformations of the 20th century.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 270 Modern Middle East (3 credit hours)
Social and political change in the Middle East in the nineteenth and twentieth centuries. Decline of the Ottoman empire, the rise of nationalism, the waxing and waning of European imperialism in the region, and the creation of modern states and societies and their ideological and economic underpinnings.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 275/AFS 275 Introduction to History of South and East Africa (3 credit hours)
The African kingdoms (Lunda, Buganda, and Zulu); the European encroachment; the origins of colonialism and the character of colonial societies and economies, South African apartheid; African protest, nationalism and independence.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 276/AFS 276 Introduction to History of West Africa (3 credit hours)
The history of Western Africa. Forest civilizations and the slave trade, trade and the expansion of Islam, colonialism in West Africa; African nationalism and the achievement of independence; and postcolonial West Africa.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

HI 300 History Methods and Writing (3 credit hours)
Introduction to the process of researching and writing history. Techniques for locating and interpreting primary and secondary sources. Analysis and criticism of the varieties of history. The craft of historical writing. Because this course is designed to prepare students for research and writing in the History major, it should be taken before the student takes Departmental Advanced Electives in History.

R: Sophomore standing and History Majors or History Minors
Typically offered in Fall and Spring

HI 305 Frauds and Mysteries of the Past (3 credit hours)
Myths, mysteries, misconceptions, and hoaxes in history and archaeology. Examination of popular fascinations with the past, fallacies invoked in historical myths, and misappropriation of the past. Students learn about and implement methods and evidence used by scholars to interpret past peoples and events, logic, skepticism, and critical thinking, interpretative, and analytical skills. Students apply these skills in discussions, in-class activities, and creative assignments to debunk and disprove inaccurate and problematic claims about the past. Case studies of topics such as: stereotypes about early humans, Atlantis, mythical beasts, pyramid alignment, conspiracy theories, art fakes and forgeries, and alien visitations.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 307 Jewish History (3 credit hours)
Survey of major topics in the history of the Jews, focusing on the development of Jewish life on the European continent but also covering the patterns of migration that created a global diaspora as well as the forces that formed modern Israel.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 317 Cuba Today: Historical and Sociopolitical Perspectives (3 credit hours)
This course, offered in Havana, Cuba, through the Study Abroad Office, examines Cuban political, social and economic dynamics through historical and sociopolitical perspectives. It explores the process and legacy of colonization, the role of slavery in colonial society, Santeria, healthcare, education and international relations in revolutionary Cuba. In order to take this course, students must be degree seeking and it must count towards their degree.

GEP Global Knowledge, GEP Humanities
Typically offered in Summer only

HI 318 Environmental History of Cuba: Prehistory to the Present (3 credit hours)
This course, offered in Havana, Cuba, is designed to introduce students to the environmental history of the country, from the pre-history to present. Among the core topics examined are the social, economic and environmental impacts of sugar, tobacco and coffee cultivation, the relationships between animal husbandry and deforestation, and the history of foreign tourism and its environmental implications. The course closes with an examination of the "Special Period" in Cuba beginning in 1989, and the rise of organic and urban agriculture in Cuba. In order to take this course, students must be degree seeking and it must count towards their degree.

GEP Interdisciplinary Perspectives
Typically offered in Summer only

HI 320/REL 320 Religion in American History (3 credit hours)
Representative people, movements and thought in the major religions within the context of American society and culture.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 321 Scientific Revolution and European Society, 1500-1800 (3 credit hours)
Exploration of the changing role that the arts, technology, and sciences played in shaping early modern European culture, society, and global power, between 1500 and 1800. Examination of the historical context of developments such as machine-making, new scientific ideas, patronage of science and technology, the formation of distinct technical and scientific fields, nation-building projects, and global ventures.

GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 322 Rise of Modern Science (3 credit hours)
Analysis of how "modern" science developed in Europe since the 1500s, exploring the foundation of the ideas, scientific practices, institutions, and cultural meaning and power of science in modern society. Examples taken from the creation of the mechanistic worldview and Newtonian science, and the development of modern disciplines such as chemistry, geology, biology, and physics.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 323 Science, American Style (3 credit hours)
Exploration of the distinctive nature of American science and its place in American culture. Analysis of the historical context of developments, such as early contributions to science, natural history, and paleontology; the growth of professionalization of science; ideas about scientific management and social applications such as eugenics; and the creation of the atomic bomb and the rise of "Big Science" after WWII.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 324 History of Common Law and Constitution (3 credit hours)
Survey of the development of common law and constitution from the earliest Roman and Anglo-Saxon beginnings to the era of the French and American Revolutions. The focus will be on the European social, political and intellectual contexts within which Anglo-American law emerged, and the foundations of legal and constitutional principles. Topics include the origins of courts and the judiciary; the evolution of jury trial and the early history of the law of evidence; conflicts and compromised between secular and ecclesiastical law; rights and limits to property ownership at common law; and problems regarding the legal status of women, children, servants and slaves.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 332 Germany and the World Wars (3 credit hours)
Germany's rise as a world power in the years prior to World War i, the emergence of Adolf Hitler and national socialism, and the consequences in defeat of World War II. Topics include nationalism, industrialism and the struggle of workers, imperialism, religious minorities and racial theories, sexual revolution, democratization, international relations and war, postwar occupation and reconstruction, and popular culture in music and film.

Prerequisite:3 hrs of History or Sophomore Standing
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 335 The World at War (3 credit hours)
Comparative history of the experience of war over time and place. Topics include the interactions between war and society; effects on combatants and non-combatants, especially women and children; and the role of technology.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 337 Spy vs. Spy: Cold War Intelligence History (3 credit hours)
This course will examine the often deadly intelligence efforts that characterized the Cold War (USA vs. USSR) of 1945-1991. While the history of that era marks the major political, economic, and military events, much occurred in the shadows. This wide-ranging intelligence competition affected - and was affected by - both American and Russian societies and cultures. Drawing on selected readings, this course will seek to describe this struggle to know and to conceal, and offer useful context to explain how and why it influenced the course of the Cold War.

GEP Humanities
Typically offered in Spring only

HI 338 Empire, War, and Revolution in Russia (3 credit hours)
Survey of Russian history since the advent of modern reform following the 1861 Serf Emancipation. The course treats the failure of an increasingly outdated monarchy to cope with the rise of an influential urban educated class, and industrial work force, and Populist and Marxist revolutionary movements. The course traces the degeneration of the 1917 socialist revolution into a hardened dictatorship which, forced by conditions outside its control, waged a destructive but victorious war, saving Europe from Nazism. It treats the 1991 Soviet collapse and the challenges and failures of the post-Stalin and post-Soviet periods.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 340 History of Agriculture (3 credit hours)
An introduction to the history of agriculture from a global perspective. The course explores our evolving relationship with plants and animals, including the earliest experiments in domestication and husbandry, short- and long-term developmental trajectories, local- and global-scale patterns, and coverage of diverse places and times. Themes include agricultural practices, food systems, landscape transformations, technological innovations, social and political organization, inequality, exploitation, food security, and sustainability.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 341 Technology in History (3 credit hours)
The role of technology in society from earliest times to the present. Major achievements in technology and an examination of the nature of invention, innovation and adaptation of technologies and their impact on Western Civilization.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 342 Global Environmental History (3 credit hours)
Environmental history from a global perspective, covering a broad time span and examining both how humans have shaped their environment and how they are shaped by it. Topics include hunter-gatherer societies, the environmental forces which fostered sedentary societies, the rise and fall of early civilizations, and the relationship of water, wind, coal, steam, petroleum and other energy forms to human development and environmental processes. Examination of the dynamic interplay between the environment and social forces such as trade, imperialism, labor, public health, population growth, consumption, and social movements.

GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

HI 344 Dinomania: Dinosaurs in Culture and Science (3 credit hours)
The cultural and scientific history of dinosaurs as simultaneously an object of scientific knowledge and of popular culture. Attention will be paid to early dinosaur discoveries and interpretations, the competitive exploration for dinosaurs in the US West and other exotic places, the origin and international spread of dinomania, dinosaurs as cultural icons, and the ways that dinosaurs have been represented in the media and in public museums. This course will include critical discussion of how natural science is done, how ideas about dinosaurs are culturally embedded, and how and why those ideas change over time.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 345 American Popular Culture (3 credit hours)
Popular culture as reflection of as well as contributor to American historical trends. Changes in forms of entertainment (music, books, popular art, theater, film, television, etc.), from the artisanal culture of the late 18th century through the rise of 19th- and early 20th-century commercial culture to the evolution of mass media culture in the late 20th and early 21st centuries.

GEP Humanities
Typically offered in Spring only

HI 346 The Civil War Era in Popular Culture (3 credit hours)
Survey of the causes, trajectories, and consequences of the American Civil War and the social, political, and economic struggles of Reconstruction. Draws on history and literary studies to investigate how Americans represented and misrepresented the Civil War era, through an examination of popular culture. Emphasis on conflicts concerning regional identity, race, class, gender, and sexuality in the history and memory of the Civil War era.

GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HI 350 American Military History (3 credit hours)
American military experience and its relationship to other historical developments. Use of military force in terms of strategy and tactics and as an element in the nation's diplomatic, political, social, economic and intellectual life.

GEP Humanities
Typically offered in Fall only

HI 351 U.S. Naval History (3 credit hours)
The role of the U.S. Navy in American history. Sea power, national defense and foreign policy. The impact of technology on naval warfare and the historical evolution of missions of the U.S. Navy.

GEP Humanities
Typically offered in Spring only

HI 354 The Rise of the American Empire (3 credit hours)
This course investigates the rise of the American Empire from the Spanish American War of 1898 through the 2001 attacks on the World Trade Center. The purpose of the course is not only to acquaint you with the crises and triumphs of US foreign policy from 1898 to 2001, but also to help you develop your own analysis of whether the acquisition of empire was accidental or deliberate, or a combination of both.

GEP Humanities
Typically offered in Spring only

HI 360 U.S. Agricultural History (3 credit hours)
U.S. Agricultural history from colonial era to present. Attention to the major economic, social, political, environmental and cultural forces that shaped American agriculture from the 16th century to 21st century. Discussion of the role of technological change and evolution of governmental policy in U.S. agriculture. Exposure to major episodes demonstrating fundamental changes and continuities in U.S. agriculture. Discussion of the diversity of American farmers and farmworkers and their struggles for equality and access.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 361 Global History of American Food and Drink (3 credit hours)
Interdisciplinary examination of food and drink, exploring major food cultures around the world, global food trends from the Columbian Exchange of the 1400s and 1500s through increased globalization to industrialization, and the recent history of American food, foodways, and food problems.

GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 364 History of North Carolina (3 credit hours)
History of North Carolina from early European exploration to the present. Features of North Carolina society which made this state similar to and different from other southern states and the nation as a whole.

GEP Humanities
Typically offered in Fall, Spring, and Summer

HI 365 The American West (3 credit hours)
A history of the American borderlands with emphasis on the trans-Mississippi West. Cycles of exploration, conquest, and exploitation of this region. Influence of the frontier in the development of the United States.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 366 Native American History (3 credit hours)
An introductory interpretation of the varied historical experiences of many nations native to North America from the first migrations of peoples into the continent until the present, including the variety and diversity of Indian cultures and experiences; native resistance to colonialism, expansion, and U.S. federal policies; and the survival and continuity of native cultures and peoples through more than four centuries of contact, conquest, and change.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 369 Sexuality in U.S. History (3 credit hours)
Exploration of the social construction of sexualities from the early seventeenth century to the present day. This course will focus on the United States, but we will begin with the history of sexuality in early modern Europe to see where ideas of sexuality in colonial America had their roots. We will proceed through the chronological development of the history of sexuality in North America. Throughout the semester, we will explore dominant and alternative constructions of sexuality; trace the changing and contested meanings of sexuality; and explore the implications of these understandings in sexuality for power relations in the history of the United States. While issues of gender and race frequently intersect with sexuality, we will be focused primarily on the latter.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 370 Modern Egypt (3 credit hours)
Exploration of the political, socio-economic, and cultural history of Egypt from the end of the 18th century (the 1798 exploration led by Bonaparte) to the present day; including the late Ottoman period (1798-1805), the birth of the modern state (1805-1922), Egypt's liberal experiment (1922 - 1952), the Nasser era (1952-1970), the neo-liberal age (since 1970), and concluding with the January 25th Revolution. The investigation follows two main threads: the conflictual relationships that developed over the past two centuries between the state and society in all its diversity, and the continuous struggle over the definition of the Egyptian nation that these conflicts have generated.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring and Summer

HI 371 Modern Japan, 1850 to Present (3 credit hours)
Survey of Japan's emergence as a modern nation and world power. Topics include nation-state formation; modernization and its dislocations; democratization and authoritarianism; imperialism, international politics, and war; postwar reforms; changing gender relations; popular culture; and social problems.

Prerequisite: 3 hours of History or Sophomore standing
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 372/AFS 372 African-American History Through the Civil War, 1619-1865 (3 credit hours)
African background and continuity of the particular role, experience and influence of African Americans in the United States through the Civil War.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 373/AFS 373 African-American History Since 1865 (3 credit hours)
The history of African-Americans from the Reconstruction era through the Civil Rights movement of the 1950s and 1960s to the present.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 374 Visual Culture of Modern South Asia (3 credit hours)
History of visual-cultural production in expressing and shaping socio-political configurations in the South Asian subcontinent. Treats visual evidence over 300 years to understand the integrative relationship and flow of cultural production across elite patronage and popular values through common themes and stories. Changing state formations and power relationships-- from the Mughal empire and its successor states through British imperial control and after independence-- are studied as contexts for the visual culture that emerges and changes across these time periods. Knowledge gained from HI 263 [Asian Civilizations to 1800] or HI 264 [Modern Asia] is helpful but not required.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 375 Global History of Travel and Tourism (3 credit hours)
This course traces the development of travel and tourism from ancient times to modern days, examining it as an agent that both produces and reflects social-cultural activities. It draws on different travel-energized materials-from topographic descriptions to sentimental narratives-to examine how people traveled long distances for various reasons and to analyze their impressions of foreign lands and reflections on their home population. Topics include how the crossing of boundaries reflected and reshaped the meanings of place, the formation of identity, the spread of religion and aesthetics, the accumulation of knowledge and scientific empiricism, as well as the consumption of visual and material culture.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 376 Global Migrations (3 credit hours)
Global Migrations examines human mobility from the early modern period to the present. Challenging popular assumptions about who migrates, where they move to, and why, it explores mobility as a fundamental element of how empires, states and societies came to be. Special attention will be paid to cross-cultural connections made possible by migrant populations, questioning whether "globalization" is only a twentieth century phenomenon. The course provides a basic knowledge of major global migration movements, from the Mongols and the Silk Road to the Atlantic slave trade, twentieth century labor migrations and contemporary issues such as trafficking, statelessness and diaspora politics. Throughout, it examines the challenges and opportunities that migrations pose for immigrants, as well as sending and receiving societies.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 377 The Silk Road in the Medieval World (3 credit hours)
Historical examination of the "Silk Road," the collection of trade routes across Eurasia that connected "East" and "West," as a pre-modern form of globalization. Focus is on the heyday of the Silk Road in the medieval period, ca. 350 - 1450 CE, and its roots in the Han and Roman Empires of classical antiquity up to its transformation in the early modern sea routes and colonization of the Americas. Topics include trade and the production of silk and porcelain, the transmission of religions and technologies, travel and travelogues, foodways, and trans-national empires of medieval China and medieval Europe.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 380 History of Nonprofits, Philanthropy, and Social Change (3 credit hours)
This course explores the historical development of nonprofits and philanthropy in the United States from the colonial period to the present: the origins of charity and philanthropy as concepts for social change and social justice, the rise of benevolent societies in the nineteenth century, the creation of philanthropic foundations and advocacy organizations in the twentieth century, and the construction of complex relationships between modern nonprofits, the state, and the private sector.

GEP Humanities
Typically offered in Spring only

HI 381 NGO Nonprofits in a Global Context (3 credit hours)
Non-Governmental Organizations (NGOs) are a crucial component and a revealing characteristic of the strength and effectiveness of a country's civil society. Examining their histories outside of the U.S. gives us a window into global culture, values, and modes of everyday life, and into notions about "charity" and "public good" in a given society. We will use India as a case study to develop a set of questions about how NGOs function in different societies, examining how researchers and activists partner with NGOs in different parts of the world to address pressing environmental, economic, social, and cultural-production issues.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 382 History of Capitalism in America (3 credit hours)
The phrase "capitalism in America" raises big questions, and this course will look at such questions as: What is capitalism anyway? What was the relation between slavery and capitalism? Is capitalism the story of heroic entrepreneurs who through vision and courage built new enterprises? Has the government played any positive role in American capitalism or has it just stood in the way? Is fraud an aberration or an essential part of capitalism? Why has America had all these financial crises and how have Americans responded to them? Is capitalism in the twenty-first century something new or is it just a continuation of longer trends? Is it even reasonable to talk about capitalism in the United States alone?

GEP Humanities, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HI 385 Introduction to Public History (3 credit hours)
History is about people: their societies, economies, cultures, and politics and how these changed over time. In Public History, history is also for people, in that careful and exacting historical research can facilitate dialogue and be applied to contemporary problems. Just as important, Public History is history saved, researched, and analyzed with people, for public historians work with individuals and groups to collaboratively understand history and preserve historical resources for future generations. This class treats the major concepts, scholarship, and research methods shaping the Public History field; it is also an opportunity to test the fields theories in projects that will create new resources for historical learning in our community. Required field trip fee of $10.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Summer

HI 386 Introduction to Museum Studies (3 credit hours)
Museums and their curating practices in a global context. Topics include the social, cultural, and political positions of museums and the evolution of their functions; the role of collector, the curator, and the visitor; and theories and practices of display and representation of objects and culture. Students will gain hands on experience with how museums produce, interpret, and exhibit knowledge.

Typically offered in Spring only

HI 390 Internship in History (3 credit hours)
Directed work experience for history students with internship-site mentoring and evaluation. Engagement in the community as a practitioner. Course requires 140 contact hours with the sponsoring organization. The course includes an on-campus class meeting and presentation at the end of the semester. Students must have at least a 3.0 overall GPA and at least a 3.0 GPA in the major, be a junior or senior, and must complete the application process with the Department of History. Students must provide their own transportation to the internship site. Modest liability insurance fee required.

Prerequisite: Juniors & Seniors with Cumulative GPA of 3.0 or above and 3.0 GPA or above in History courses, HI 300 and 12 hours of History courses and consent of the department
Typically offered in Fall, Spring, and Summer

HI 395 History: Study Abroad (1-3 credit hours)
Topical History courses taught in NCSU Study Abroad programs. (Current listings available in Study Abroad Office, CHASS Dean's Office and History Department).

Prerequisite: 3 hours of History or Sophomore standing

HI 399 Special Topics in History (1-3 credit hours)
Timely topical courses or experimental course offerings in intermediate-level historical study. Students cannot receive credit for multiple sections of HI 399 unless the topics are different.

Typically offered in Fall, Spring, and Summer

HI 400/HI 500 Civilization of the Ancient Near East (3 credit hours)
The civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C. Credit for both HI 400 and HI 500 is not allowed

Prerequisite: 3 hours of History
Typically offered in Fall only

HI 402/REL 402 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox Christian movements; anti-heretical writings; orthodox institutions of authority. Students may not receive credit for both REL /HI 402 and REL/HI 502.

Prerequisite, one of: REL 312, REL 317, or HI 207.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 403/HI 503 Ancient Greek Civilization (3 credit hours)
The history of the Hellenes from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides. Credit will not be given for both HI 403 and HI 503.

Typically offered in Spring only

HI 404/HI 504 Rome to 337 A.D. (3 credit hours)
The development of ancient Rome from its origins in Italy, through the rise as an Empire embracing the entire Mediterranean World and Western Europe, to Constantine, Christianity and the foundation of Constantinople. Examines critically the political achievement of a people who rose from an obscure Italian city to a world empire, with emphasis on the analysis of primary sources. Credit will not be given for both HI 404 and HI 504

P: 3 hrs. of History

HI 405/HI 505 History and Archaeology of the Roman Empire (3 credit hours)
Analysis of Rome's rule over the Mediterranean World in the first four centuries A.D. through the use of literary and archaelologic sources. Special emphasis on imperial army and frontier security. Credit will not be given for both H1 405 and H1 505

P: 3 hrs. of History

HI 406/HI 506 From Roman Empire to Middle Ages (3 credit hours)
Late Antiquity and the early Middle Ages. The transition from classical civilization to the basis of modern civilizations; the fall of Rome, the Germanic kingdoms, Byzantium, the establishment of Christianity, the birth and growth of Islam. Credit will not be given for both HI 406 and HI 506

P: 3 hrs. of History
Typically offered in Spring only

HI 407/REL 407 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: 3 hrs HI or REL 300 or above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 408/REL 408 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.

Prerequisite: 3 hours of history or religious studies
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

HI 409/HI 509 The High Middle Ages (3 credit hours)
Medieval culture from 10th through 13th centuries: revival of the Roman Empire, monastic and papal reform, rise of universities, evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism, and revival of Roman law. Credit will not be given for both HI 409 and HI 509

P: 3 hrs. of History

HI 410 Italian Renaissance (3 credit hours)
The historical, literary, and cultural developments defining the "Renaissance" period of Italian history from the late fourteenth century to the end of the sixteenth century. Topics include critical analysis of the concept of a "renaissance" and its usefulness for historical interpretation; the intersection of politics, religion, society, art, and literature in relation to defining a "Renaissance" culture; and the development of a global money economy and the cultural output it inspired in Europe.

P: 3 hrs. of History
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Summer

HI 411/HI 511 Trials of Faith: Religious Reformation in Early-Modern Europe (3 credit hours)
Examination of the great disruption in European civilization associated with the Protestant and Catholic Reformations. The course considers the new religious ideas and practices associated with the Reformations and transformation they produced in European political and economic life; the violence they provoked; the new thinking about families and gender roles they encouraged, the spread of European religions around the globe with European voyages of discovery and conquest, and the beginning of ideas about religious toleration. Credit will not be given for both HI 411 and HI 511.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 412/HI 512 The Sexes and Society in Early-Modern Europe (3 credit hours)
Examination of changes in gender relations; ideas about the sexes, femininity, and masculinity; the roles of women and men in political, religious, economic, scientific, and family life in Europe between the late Middle Ages and the French Revolution. Credit for HI 412 and HI 512 is not allowed.

P: 3 hrs. of History
GEP Global Knowledge

HI 414/HI 514 From Kings to Revolution: The History of Early-Modern France (3 credit hours)
Examination of the most politically powerful and culturally dominant kingdom in early-modern Europe, which dissolved into a revolution that destroyed its monarchy while establishing ideas about democracy and equality. From the glories of the Versailles palace to the misery of peasant villages, topics include the beginnings of the French state and nation in the warfare and religious conflicts of 1500s, political and economic developments, the growth of an internationally influential French culture, religious change, controversies over gender roles, and the origins of the French Revolution. Credit will not be given for both HI 414 and HI 514.

P: 3 hrs. of History
GEP Global Knowledge

HI 415/HI 515 The French Revolution (3 credit hours)
Broadly based analysis of France's first revolutionary era; the enlightenment and its impact, the causes and character of the Revolution in France; impact of these events in France and Europe. Credit will not be given for both HI 415 and HI 515

P: 3 hrs. of History
GEP Global Knowledge

HI 418/HI 518 Fascist Italy and Nazi Germany (3 credit hours)
Fascism as a theoretical concept, rise of fascism in Italy and Germany, seizure of power by Mussolini and Hitler, organization of the economy, churches, military, women, youth, and culture under the dictatorships. Students will not receive credit for both HI 418 and HI 518

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 419/HI 519 Modern European Imperialism (3 credit hours)
Historical background of European overseas expansion; its impact on the economics, politics and culture of both Europe and the colonized world; the significance of imperialism and anti-colonial nationalism in shaping the modern world. Credit will not be given for both HI 419 and HI 519

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 421/HI 521 European Intellectual History: The Eighteenth Century (3 credit hours)
Historical examination of some of the major figures of the European Enlightenment, beginning with Locke and ending with Kant. Credit will not be given for both HI 421 and HI 521

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 422/HI 522 European Intellectual History: The 19th Century (3 credit hours)
Historical examination of some of the major figures of European thought during the 19th century, beginning with the enthusiasm of the period of the French Revolution and ending with the disillusionment of the fin de siecle. Credit will not be given for both HI 422 and HI 522

P: 3 hrs. of History
GEP Global Knowledge

HI 423/HI 523 Women in European Enlightenment (3 credit hours)
Historical analysis of feminist thought and action during the Enlightenment of the 1700s. Topics include women's role in the development of Western knowledge and science, historical construction of the gendered "nature" of women, education and political resources available to women, and their strategies for emancipation. Credit will not be given for both HI 423 and HI 523.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 425/HI 525 Tudor and Stuart England (3 credit hours)
British history from the Reformation through the Civil War. Emphasis on key developments in social, political and economic life: The development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry. Credit will not be given for both HI 425 and HI 525

P: 3 hrs. of History
GEP Global Knowledge

HI 429 20th Century Britain (3 credit hours)
British political, social and economic history since 1914, with reference to the effects of two world wars, the growth of the Welfare State, Britain's decline as a power, and its search for a new role in the world. Credit will not be given for both HI 429 and HI 529.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Summer only

HI 430/HI 530 Modern France (3 credit hours)
French history from the downfall of Napoleon I to the present, with a short introductory survey of the Old Regime and the French Revolution. Cultural, social and economic developments and political trends. Credit will not be given for both HI 430 and HI 530

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 434/HI 534 Theory and Practice of Digital History (3 credit hours)
Introduces students to the theory and practice of digital history. Students will examine theoretical scholarship on digital practices in history, learning how to acquire, edit, process, analyze, and present humanistic data. Students will critique examples of digital history including digital archives, exhibits, scholarship, and teaching resources, and then apply conceptual knowledge in the creation of their own digital history projects. The course is geared to students without prior knowledge of coding. Credit will not be given for both HI 434 and HI 534.

R: Graduate Standing or PBS
Typically offered in Fall only

HI 437 Topics in Central and East European History (3 credit hours)
Topical focus on specific problems and events occurring in the region in and between Germany and Russia in modern history. The course is designed to expose advanced undergraduates, principally history majors, to intensive reading, writing, and discussion of focused topics in the subject area. Previous modern European history credit is advised. This course is repeatable once for credit when offered with a different topic.

P: 3 hrs. of History
Typically offered in Spring only

HI 440/HI 540 American Environmental History (3 credit hours)
Interactions between humans and their environments in America; environmental focus on themes in American history such as colonial settlement, industrialization, progressivism, the New Deal, the 1960s. Credit will not be given for both HI 440 and HI 540.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

HI 441/HI 541 Colonial and Revolutionary U.S (3 credit hours)
Origins of the English colonies in America to the American Revolution. European background to colonization, merging of different cultures, effects of mercantile doctrine, causes of revolution. Credit will not be given for both HI 441 and HI 541

P: 3 Hours of History

HI 443/HI 543 U.S. Constitutional History to 1883 (3 credit hours)
This course examines the origins and development of the U. S. Constitution from the Articles of Confederation to 1883. The course specifically looks at the federal Convention of 1787, the national bank debate and early constitutional interpretation;the constitution and its interaction with politics, economics, and society; the powers of Congress-taxation, contracts, commerce and war. The course also examines sovereignty, slavery and civil rights. It ends with an analysis of the Civil War Amendments and the transformation in American constitutionalism. Credit for both HI 443 and HI 543 is not allowed

P: 3 hrs. of History
Typically offered in Fall only

HI 444 U.S. Constitutional History Since 1870 (3 credit hours)
Examines the transformation of American Constitutional thought after the Civil War; the triumph of nationalism and the evolution of a new federal theory; the rise and fall of federal protections of civil rights in the late 19th-century and the CivilRights Revolution in the 20th century. Explores key concepts as civil liberties, judicial activism and judicial restraint; procedural and substantive due process, liberty of contracts and entrepreneurial liberty, Japanese internment, privacy, women and gender issues; explores free speech, religious freedom, civil liberties. Credit for both HI 444 and HI 544 is not allowed.

P: 3 hrs. of History
Typically offered in Spring only

HI 445/HI 545 Early American Borderlands (3 credit hours)
Examines the social, political, and cultural development of the eastern American frontiers between the early seventeenth and mid-nineteenth centuries. Addresses the relationships between settlers and environments, settlers and Native Americans. Explores the structure and life of pioneer families, the development of new institutions, the role of governments in regulating settlements, and the evolution of the "frontier myth." Credit cannot be given for both HI 445 and HI 545.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 446/HI 546 Topics in Civil War and Reconstruction (3 credit hours)
Examination of the historiography of the American Civil War and Reconstruction. Topics include the origins of the war, military strategy, the northern and southern homefront, nationalism and citizenship, slavery and freed labor, changing gender roles and ideologies, struggles over racial inequality, and conservatism and radicalism during Reconstruction. Credit will not be given for both HI 446 and HI 546.

Prerequisite: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 447/WGS 447/HI 547/WGS 547 Women in America: From Contact to the Civil War (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 448/WGS 448/HI 548/WGS 548 American Women in the Twentieth Century (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 449/HI 549 U.S. Labor to 1900 (3 credit hours)
This course explores the history of work, workers, and working-class life and labor in the United States from the founding of the first European colonies to the beginning of the twentieth century: bound and free labor in colonial America, the transformation of urban worklife in the decades preceding the Civil War, slavery and class formation in the antebellum South, the effects of immigration on American workers, and the impact of race and gender on workers' solidarity. Credit will not be given for both HI 449 and HI 549.

P: 3 hrs. of History
GEP U.S. Diversity

HI 450 U.S. Labor Since 1900 (3 credit hours)
This course explores the history of work, workers, and working class organizations in the twentieth century United States; with particular attention to three core issues in twentieth-century American labor history: whether the US South has a particular form of labor history; the historical struggle for workersÂ¿ rights to collectively act and protest; and the intersections between race, ethnicity, immigration and labor in the twentieth-century US. Credit will not be given for both HI 450 and HI 550.

P: 3 hrs. of History
GEP U.S. Diversity

HI 451/HI 551 The Vietnam War (3 credit hours)
The Vietnam War in Vietnamese historical context. A study of major works on the legacy of French colonialism; the growth of Vietnamese radicalism and communism; World War II and the Vietnamese Revolution; the French Indochina War and political division; nation building in north and south Vietnam; conflict between north and south; American intervention; and the memory of war in Vietnam. Credit for both HI 451 and HI 551 is not allowed.

Prerequisite: 3 hours of History
Typically offered in Spring only

HI 452/HI 552 Recent America (3 credit hours)
Examination of contemporary opinions and historical interpretations of major problems in American life since 1939, including World War II, its social and economic consequences; Korea and the Cold War, big business and labor; civil rights and feminist movements; countercultures, Vietnam and Watergate. Credit will not be given both for HI 452 and HI 552

P: 3 Hours of History

HI 453/HI 553 United States-Latin American Relations Since 1823 (3 credit hours)
Critical analysis of the last two centuries of relations between the US and Latin America. Exploration of major policies using primary sources and declassified CIA documents. Major themes include US economic, political, and military influence, covert and overt US interventions, and response by Latin American governments. Historical perspectives on contemporary inter-American problems such as drugs, environment, debt crisis, human rights abuses, and the impact of the Latino population in the U.S. Credit will not be given both for HI 453 and HI 553.

Prerequisite: 3 hrs. of History
Typically offered in Spring only

HI 454 History of U.S. Foreign Relations, 1900-Present (3 credit hours)
America's emergence as a world power; American diplomatic history since 1900; the expansion of American economic and cultural relations; the evolution of the American foreign policy bureaucracy; and the historical forces and personalities that have shaped American relations with other nations. Credit for both HI 454 and HI 554 will not be allowed

P: 3 hrs. of History

HI 455/AFS 455/HI 555/AFS 555 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 459/HI 559 The Early American Republic (3 credit hours)
Examines the social, political, and cultural development of the Early Republic, the period in American history roughly from the Revolutionary War through the Administration of John Quincy Adams. Employs the life of Thomas Jefferson-the quintessential American, as the foundation for delving into the historical problems, interpreting primary sources, and analyzing secondary sources. Encourages graduate students to analyze the ways in which historiographic debates complicate our understanding of the Early American Republic. Credit will not be given for both HI 459 and HI 559.

Prerequisite: 3 hrs. of History

HI 461/HI 561 Civilization of the Old South (3 credit hours)
The distinctive features of the Old South as part of the regional development of United States history. Consideration of colonial factors in the making of the South, development of the plantation system and slavery, Southern social order, intellectual and cultural life, economic development, and rise of Southern nationalism. Credit will not be given for both HI 461 and HI 561

Prerequisite: 3 hrs. of History

HI 462/HI 562 Southern History since the Civil War (3 credit hours)
Exploration of many American "Souths" from Reconstruction to the present. How race/ethnicity, gender, class, geography, sexuality, and culture inform "Southern" identity; major political and economic changes; and the region's relationship to the nation and the world. Credit will not be given for HI 462 and HI 562.

Prerequisite: 3 hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

HI 463/HI 563 Topics in History and Memory (3 credit hours)
Explores how "collective memory" develops. Examines how memory is represented through public speeches, civic celebrations, monuments and memorials, and other forms of popular and political culture. Analyzes what is recalled, what is forgotten, and who decides. Asks why memory is made public. May be repeated once for credit when offered with a different topic. Credit will not be given for both HI 463 and HI 563.

Typically offered in Fall, Spring, and Summer

HI 465 Oil and Crisis in the Gulf (3 credit hours)
Historical roots and development of the Persian Gulf region from the late nineteenth century until the present with an emphasis on the social, economic, cultural and political transformations following the discovery of oil, and subsequent events such as the Arab Oil embargo of 1973, the Iranian Revolution, the Iran-Iraq war, and the two Gulf wars.

P: 3 hrs. of History
GEP Global Knowledge

HI 466 History of the Palestinian-Israeli Conflict (3 credit hours)
Historical roots and development of the Palestinian-Israeli conflict from the late nineteenth century until the present through the study of the history and historiography of Zionism, Palestinian nationalism, creation of the state of Israel, establishment of settlements, conflicts and peace negotiations, as well as a study of the impact of this conflict on both Israeli and Palestinian societies, economies and cultures.

P: 3 hrs. of History
GEP Global Knowledge

HI 467 Modern Mexico (3 credit hours)
Major developments in Mexican national life since 1821. The 19th century: the era of Santa Anna, the war with the United States, the Reform, the French intervention, and the dictatorship of Profirio Diaz. The 1910 Revolution and the resulting transformation of Mexico's political, social and economic institutions. Reading knowledge of Spanish helpful but not required.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 468/HI 568 Slavery in the Americas (3 credit hours)
Exploration of the development of chattel slavery throughout the Americas. Analysis of the emergence and development of New World slavery in ways that encourage students to think critically about the historical processes of abolition, emancipation, and freedom across the Atlantic world. The lectures and readings seek to dislodge the notion that the "history of slavery" only pertains to the United States. The course, instead, emphasizes commonalities and differences in ways that challenge assumptions that the institution was exceptional in any given region. Credit will not be given for both HI 468 and HI 568.

Prerequisite: 3 Hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 469/HI 569 Latin American Revolutions (3 credit hours)
Comparative analysis of causes, participants, process, and outcome of revolutions in Mexico, Bolivia, Cuba, and Central America. Credit for both HI 469 and HI 569 will not be given

Prerequisite: 3 Hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 470/HI 570 Exploring World History (3 credit hours)
Introduction to the methods, themes, and narratives of world history. As a distinct approach to historical study, world history focuses on dynamic connections and relationships among regions of the world and the variety of global processes - related to trade, religion, production, consumption, migration, imperialism, disease, and technologies - that connected them. The course is a suggested elective for future teachers who will teach world history in high school, as well as an ideal course for History majors and graduate students who want to explore the connections among all the regionally specific upper division courses they have taken. Credit will not be given for both HI 470 and HI 570.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 471/HI 571 Revolutionary China (3 credit hours)
China 1900 to present. Examination of political, cultural, and socio-economic revolutionary phases of China's 20th-century transformation from traditional empire to communism. Particular attention to post-1949 problems of nation-building. Credit will not be given for both HI 471 and HI 571

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 472 Fashion, Food, and Fun: Material Culture in Chinese History (3 credit hours)
Exploration of the history of everyday material culture in China, covering a wide range of physical objects such clothes, tea, architecture, and woodblock printing. Examination of how the material culture of different time periods evolved in response to varying historical factors and contributed to the formation of cultural norms. Focus on both textual and visual historical records, as well as objects from the Gregg Museum.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 473/HI 573 Japan's Empire in Asia, 1868-1945 (3 credit hours)
An advanced survey of Japanese relations with Asia in the nineteenth and twentieth centuries. Structures and ideologies of imperialism and colonialism; modernization, nationalism and social change; migration and mobility; resistance and collaboration; and legacies of empire. Credit will not be given for both HI 473 and HI 573

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 474 Modern India (3 credit hours)
The history of the Indian sub-continent, from the 16th century to the present. Focus on political, economic and cultural change under the Mughal Empire and the British Raj; the problems of independent India, Pakistan and Bangladesh.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 475/AFS 475/HI 575/AFS 575 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa's society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

HI 476/AFS 476/HI 576/AFS 576 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of history
GEP Global Knowledge

HI 477 Women in the Middle East (3 credit hours)
The varied forces influencing lives of women in Middle East from beginning of Islam to present.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 478 Islam and Christianity in Sub-Saharan Africa (3 credit hours)
Expansion and interaction of Islam and Christianity in sub-Saharan Africa in the nineteenth and twentieth centuries, and their influence and impact on the economy, politics, and society. Topics include missionary activity, resistance to imperial authority, the role of the churches, and the influence of religion on leadership, education, nationalism, and post-colonialism. Credit will not be given for both HI 478 and HI 578.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall only

HI 479/AFS 479/HI 579/AFS 579 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 481/HI 581 History of the Life Sciences (3 credit hours)
Historical context of the individuals, ideas, scientific practices, and social goals that created the core concepts of the modern biological sciences, from Renaissance medicine to molecular biology, with a focus on interconnections of the scientific knowledge and perspective of the life sciences with other aspects of culture, including other sciences, views about nature and life, religious belief, medical practice, and agriculture. Topics include the development of biological experiments; theories of ecology and evolution; the chemical understanding of health, food, and drugs; and the modern molecular revolution. Credit will not be given for both HI 481 and HI 581.

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 482/HI 582 Darwinism in Science and Society (3 credit hours)
Scientific development of Darwinism and its reception by the scientific community and the general public. Social impact of theories of evolution as reflected in Social Darwinism, eugenics, sociobiology, and relationship of sciences to ethics and religion. Credit will not be given both for HI 482 and HI 582

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 483/HI 583 Science and Religion in European History (3 credit hours)
Are science and religion inherently in conflict with each other? Historical analysis of the idea of the Â¿warfare between religion and science,Â¿ treating their complex relationship and respective cultural authority before 1800, including the relationship of science and religion in Europe during periods of the Reformation, the creation of early modern states, and the Enlightenment of the 1700s. Topics include visions of nature and utopias, the creation of mechanistic science in the 1600s, and natural theology. Credit will not be given for both HI 483 and HI 583.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 484/HI 584 Science in European Culture (3 credit hours)
The role of science in shaping early modern European identity, culture and polity in the 1600s and 1700s. Drawing on documents and material culture, topics include the meaning of natural wonders, explorations, travel literature, instruments and mapping, colonies and empire, and universal expos. Credit will not be given for both HI 484 and HI 584.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 485/HI 585 History of American Technology (3 credit hours)
Technology in American history: the ideological, social, economic, and institutional contexts of technological change from the 1760's to the present. Impacts of new technological systems. Credit will not be given for both HI 485 and HI 585.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 486/HI 586 Science and Empire (3 credit hours)
The development of European science in the context of world exploration, global commercial expansion, local knowledge, and visions of colonization and empire. Credit will not be given for both HI 486 and HI 586.

Prerequisite: 3 hours of History
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 488/HI 588 Family and Community History (3 credit hours)
Theory and research in family history, local history, and community studies, as well as application to public history presentation and community development. Students cannot receive credit for both HI 488 and HI 588.

P: Graduate Standing
Typically offered in Fall only

HI 491 Seminar in History (3 credit hours)
Detailed investigation of selected topics in history. Consult Department of History for specific topics.

Prerequisite:HI 300 and 18 hours of History
Typically offered in Fall and Spring

HI 494 Honors Directed Readings in History (3 credit hours)
Directed readings course covering the literature of a broad historiographical field, from which the student should ultimately draw a more specialized topic for an Honors Thesis (HI 495 and HI 496). Both written and oral assignments based on the assigned reading may be made. Enrollment requires a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and instructor prior to registration by the department.

Typically offered in Fall, Spring, and Summer

HI 495 Honors Research in History I (3 credit hours)
Research and preparation of a draft honors thesis. Topic and procedures to be determined by the student and the supervising faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

HI 496 Honors Research in History II (3 credit hours)
Completion of the honors thesis. Topic to be determined by the student and the supervising faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: HI 495
Typically offered in Fall and Spring

HI 498 Independent Study in History (1-6 credit hours)
Extensive readings on predetermined topics focused around a central theme. Permission of the department is required. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: 3 hours of History

HI 499 Special Topics in History (1-3 credit hours)
Timely topical courses or experimental course offerings in advanced historical study.

Prerequisite: 3 hours of History
Typically offered in Fall and Spring

HI 500/HI 400 Civilization of the Ancient Near East (3 credit hours)
The civilization of Mesopotamia and Egypt from earliest times to the fall of Babylon in 539 B.C. Credit for both HI 400 and HI 500 is not allowed

Prerequisite: 3 hours of History
Typically offered in Fall only

HI 502/REL 502 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox Christian movements; anti-heretical writings; orthodox institutions of authority. Students may not receive credit for both REL /HI 402 and REL/HI 502.

Prerequisite: Graduate standing
Typically offered in Fall only

HI 503/HI 403 Ancient Greek Civilization (3 credit hours)
The history of the Hellenes from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides. Credit will not be given for both HI 403 and HI 503.

Typically offered in Spring only

HI 504/HI 404 Rome to 337 A.D. (3 credit hours)
The development of ancient Rome from its origins in Italy, through the rise as an Empire embracing the entire Mediterranean World and Western Europe, to Constantine, Christianity and the foundation of Constantinople. Examines critically the political achievement of a people who rose from an obscure Italian city to a world empire, with emphasis on the analysis of primary sources. Credit will not be given for both HI 404 and HI 504

P: 3 hrs. of History

HI 505/HI 405 History and Archaeology of the Roman Empire (3 credit hours)
Analysis of Rome's rule over the Mediterranean World in the first four centuries A.D. through the use of literary and archaelologic sources. Special emphasis on imperial army and frontier security. Credit will not be given for both H1 405 and H1 505

P: 3 hrs. of History

HI 506/HI 406 From Roman Empire to Middle Ages (3 credit hours)
Late Antiquity and the early Middle Ages. The transition from classical civilization to the basis of modern civilizations; the fall of Rome, the Germanic kingdoms, Byzantium, the establishment of Christianity, the birth and growth of Islam. Credit will not be given for both HI 406 and HI 506

P: 3 hrs. of History
Typically offered in Spring only

HI 507/REL 507 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: Graduate Standing
Typically offered in Fall only

HI 508/REL 508 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.

Prerequisite: Graduate Standing
Typically offered in Fall only

HI 509/HI 409 The High Middle Ages (3 credit hours)
Medieval culture from 10th through 13th centuries: revival of the Roman Empire, monastic and papal reform, rise of universities, evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism, and revival of Roman law. Credit will not be given for both HI 409 and HI 509

P: 3 hrs. of History

HI 511/HI 411 Trials of Faith: Religious Reformation in Early-Modern Europe (3 credit hours)
Examination of the great disruption in European civilization associated with the Protestant and Catholic Reformations. The course considers the new religious ideas and practices associated with the Reformations and transformation they produced in European political and economic life; the violence they provoked; the new thinking about families and gender roles they encouraged, the spread of European religions around the globe with European voyages of discovery and conquest, and the beginning of ideas about religious toleration. Credit will not be given for both HI 411 and HI 511.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 512/HI 412 The Sexes and Society in Early-Modern Europe (3 credit hours)
Examination of changes in gender relations; ideas about the sexes, femininity, and masculinity; the roles of women and men in political, religious, economic, scientific, and family life in Europe between the late Middle Ages and the French Revolution. Credit for HI 412 and HI 512 is not allowed.

P: 3 hrs. of History
GEP Global Knowledge

HI 514/HI 414 From Kings to Revolution: The History of Early-Modern France (3 credit hours)
Examination of the most politically powerful and culturally dominant kingdom in early-modern Europe, which dissolved into a revolution that destroyed its monarchy while establishing ideas about democracy and equality. From the glories of the Versailles palace to the misery of peasant villages, topics include the beginnings of the French state and nation in the warfare and religious conflicts of 1500s, political and economic developments, the growth of an internationally influential French culture, religious change, controversies over gender roles, and the origins of the French Revolution. Credit will not be given for both HI 414 and HI 514.

P: 3 hrs. of History
GEP Global Knowledge

HI 515/HI 415 The French Revolution (3 credit hours)
Broadly based analysis of France's first revolutionary era; the enlightenment and its impact, the causes and character of the Revolution in France; impact of these events in France and Europe. Credit will not be given for both HI 415 and HI 515

P: 3 hrs. of History
GEP Global Knowledge

HI 518/HI 418 Fascist Italy and Nazi Germany (3 credit hours)
Fascism as a theoretical concept, rise of fascism in Italy and Germany, seizure of power by Mussolini and Hitler, organization of the economy, churches, military, women, youth, and culture under the dictatorships. Students will not receive credit for both HI 418 and HI 518

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 519/HI 419 Modern European Imperialism (3 credit hours)
Historical background of European overseas expansion; its impact on the economics, politics and culture of both Europe and the colonized world; the significance of imperialism and anti-colonial nationalism in shaping the modern world. Credit will not be given for both HI 419 and HI 519

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 521/HI 421 European Intellectual History: The Eighteenth Century (3 credit hours)
Historical examination of some of the major figures of the European Enlightenment, beginning with Locke and ending with Kant. Credit will not be given for both HI 421 and HI 521

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 522/HI 422 European Intellectual History: The 19th Century (3 credit hours)
Historical examination of some of the major figures of European thought during the 19th century, beginning with the enthusiasm of the period of the French Revolution and ending with the disillusionment of the fin de siecle. Credit will not be given for both HI 422 and HI 522

P: 3 hrs. of History
GEP Global Knowledge

HI 523/HI 423 Women in European Enlightenment (3 credit hours)
Historical analysis of feminist thought and action during the Enlightenment of the 1700s. Topics include women's role in the development of Western knowledge and science, historical construction of the gendered "nature" of women, education and political resources available to women, and their strategies for emancipation. Credit will not be given for both HI 423 and HI 523.

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Spring only

HI 525/HI 425 Tudor and Stuart England (3 credit hours)
British history from the Reformation through the Civil War. Emphasis on key developments in social, political and economic life: The development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry. Credit will not be given for both HI 425 and HI 525

P: 3 hrs. of History
GEP Global Knowledge

HI 530/HI 430 Modern France (3 credit hours)
French history from the downfall of Napoleon I to the present, with a short introductory survey of the Old Regime and the French Revolution. Cultural, social and economic developments and political trends. Credit will not be given for both HI 430 and HI 530

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 533 Theory and Practice of Oral History (3 credit hours)
Explores the practice of oral history. Examines historical works drawn primarily from oral sources. Teaches students to design and implement oral history projects based on independent research.

Typically offered in Spring only

HI 534/HI 434 Theory and Practice of Digital History (3 credit hours)
Introduces students to the theory and practice of digital history. Students will examine theoretical scholarship on digital practices in history, learning how to acquire, edit, process, analyze, and present humanistic data. Students will critique examples of digital history including digital archives, exhibits, scholarship, and teaching resources, and then apply conceptual knowledge in the creation of their own digital history projects. The course is geared to students without prior knowledge of coding. Credit will not be given for both HI 434 and HI 534.

R: Graduate Standing or PBS
Typically offered in Fall only

HI 535 Spatial History (3 credit hours)
Introduces students to the methods, problems, and questions of spatial history. Students will examine major works in spatial history and historical geography, and develop their own projects utilizing the tools of historical GIS. Students will engage in theoretical discussions about the role of space in history and, at the same time, will acquire the skills for collecting, managing, and analyzing historical spatial data. The course is geared to students without prior knowledge of GIS. Graduate standing or PBS status.

R: Graduate Standing or PBS
Typically offered in Spring only

HI 539 History Of the Soviet Union and After (3 credit hours)
History of the Soviet state and society from the 1917 Revolution, including post-Soviet situation. Political disarray and resistance to the Bolshevik regime, 1917-21; industrialization, urbanization and application of coercive techniques of rule; popular reconciliation with Party state and great power status during World War II and after; fate of non-Russian nationalities; de-Stalinization, stagnation and failed attempt at Party renewal after 1985. Credit for both HI 439 and HI 539 is not allowed

HI 540/HI 440 American Environmental History (3 credit hours)
Interactions between humans and their environments in America; environmental focus on themes in American history such as colonial settlement, industrialization, progressivism, the New Deal, the 1960s. Credit will not be given for both HI 440 and HI 540.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 541/HI 441 Colonial and Revolutionary U.S (3 credit hours)
Origins of the English colonies in America to the American Revolution. European background to colonization, merging of different cultures, effects of mercantile doctrine, causes of revolution. Credit will not be given for both HI 441 and HI 541

P: 3 Hours of History

HI 543/HI 443 U.S. Constitutional History to 1883 (3 credit hours)
This course examines the origins and development of the U. S. Constitution from the Articles of Confederation to 1883. The course specifically looks at the federal Convention of 1787, the national bank debate and early constitutional interpretation;the constitution and its interaction with politics, economics, and society; the powers of Congress-taxation, contracts, commerce and war. The course also examines sovereignty, slavery and civil rights. It ends with an analysis of the Civil War Amendments and the transformation in American constitutionalism. Credit for both HI 443 and HI 543 is not allowed

P: 3 hrs. of History
Typically offered in Fall only

HI 544 US Constitutional History Since 1870 (3 credit hours)
Examines the transformation of American constitutional thought after the Civil War; the triumph of nationalism and the evolution of a new federal theory; the rise and fall of federal protections of civil rights. Explores key concepts such as civil liberties, judicial activism and judicial restraint; analyzes procedural and substantive due process, liberty of contracts and entrepreneurial liberty; evaluates Japanese internment, privacy, gender equality, free speech, religious freedom, civil liberties. credit not given for both HI 444 and 544

Prerequisite: Graduate standing
Typically offered in Spring only

HI 545/HI 445 Early American Borderlands (3 credit hours)
Examines the social, political, and cultural development of the eastern American frontiers between the early seventeenth and mid-nineteenth centuries. Addresses the relationships between settlers and environments, settlers and Native Americans. Explores the structure and life of pioneer families, the development of new institutions, the role of governments in regulating settlements, and the evolution of the "frontier myth." Credit cannot be given for both HI 445 and HI 545.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 546/HI 446 Topics in Civil War and Reconstruction (3 credit hours)
Examination of the historiography of the American Civil War and Reconstruction. Topics include the origins of the war, military strategy, the northern and southern homefront, nationalism and citizenship, slavery and freed labor, changing gender roles and ideologies, struggles over racial inequality, and conservatism and radicalism during Reconstruction. Credit will not be given for both HI 446 and HI 546.

Prerequisite: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 547/WGS 547/HI 447/WGS 447 Women in America: From Contact to the Civil War (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 548/WGS 548/HI 448/WGS 448 American Women in the Twentieth Century (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

HI 549/HI 449 U.S. Labor to 1900 (3 credit hours)
This course explores the history of work, workers, and working-class life and labor in the United States from the founding of the first European colonies to the beginning of the twentieth century: bound and free labor in colonial America, the transformation of urban worklife in the decades preceding the Civil War, slavery and class formation in the antebellum South, the effects of immigration on American workers, and the impact of race and gender on workers' solidarity. Credit will not be given for both HI 449 and HI 549.

P: 3 hrs. of History
GEP U.S. Diversity

HI 550 U. S. Labor Since 1900 (3 credit hours)
This course explores the history of work, workers, and working class organizations in the twentieth century United States; with particular attention to three core issues in twentieth-century American labor history: whether the US South has a particular form of labor history; the historical struggle for workersÂ¿ rights to collectively act and protest; and the intersections between race, ethnicity, immigration and labor in the twentieth-century US. Credit for both HI 450 and HI 550 is not allowed.

Prerequisite: Graduate standing

HI 551/HI 451 The Vietnam War (3 credit hours)
The Vietnam War in Vietnamese historical context. A study of major works on the legacy of French colonialism; the growth of Vietnamese radicalism and communism; World War II and the Vietnamese Revolution; the French Indochina War and political division; nation building in north and south Vietnam; conflict between north and south; American intervention; and the memory of war in Vietnam. Credit for both HI 451 and HI 551 is not allowed.

Prerequisite: 3 hours of History
Typically offered in Spring only

HI 552/HI 452 Recent America (3 credit hours)
Examination of contemporary opinions and historical interpretations of major problems in American life since 1939, including World War II, its social and economic consequences; Korea and the Cold War, big business and labor; civil rights and feminist movements; countercultures, Vietnam and Watergate. Credit will not be given both for HI 452 and HI 552

P: 3 Hours of History

HI 553/HI 453 United States-Latin American Relations Since 1823 (3 credit hours)
Critical analysis of the last two centuries of relations between the US and Latin America. Exploration of major policies using primary sources and declassified CIA documents. Major themes include US economic, political, and military influence, covert and overt US interventions, and response by Latin American governments. Historical perspectives on contemporary inter-American problems such as drugs, environment, debt crisis, human rights abuses, and the impact of the Latino population in the U.S. Credit will not be given both for HI 453 and HI 553.

Prerequisite: 3 hrs. of History
Typically offered in Spring only

HI 554 History Of U. S. Foreign Relations, 1900-Present (3 credit hours)
American diplomatic history since 1900; the expansion of American economic and cultural relations; the evolution of the American foreign policy bureaucracy; and the historical forces and personalities that shaped American relations with other nations. Credit for both HI 454 and HI 554 is not allowed

Typically offered in Fall only

HI 555/AFS 555/HI 455/AFS 455 History of the Civil Rights Movement (3 credit hours)
The black revolution; stages and leaders of the movement; successes and failures in the fight for desegregation, the vote, and economic opportunity; impact of Civil Rights movement on the United States. Credit will not be given both for AFS/HI 455 and AFS/HI 555.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HI 559/HI 459 The Early American Republic (3 credit hours)
Examines the social, political, and cultural development of the Early Republic, the period in American history roughly from the Revolutionary War through the Administration of John Quincy Adams. Employs the life of Thomas Jefferson-the quintessential American, as the foundation for delving into the historical problems, interpreting primary sources, and analyzing secondary sources. Encourages graduate students to analyze the ways in which historiographic debates complicate our understanding of the Early American Republic. Credit will not be given for both HI 459 and HI 559.

Prerequisite: 3 hrs. of History

HI 561/HI 461 Civilization of the Old South (3 credit hours)
The distinctive features of the Old South as part of the regional development of United States history. Consideration of colonial factors in the making of the South, development of the plantation system and slavery, Southern social order, intellectual and cultural life, economic development, and rise of Southern nationalism. Credit will not be given for both HI 461 and HI 561

Prerequisite: 3 hrs. of History

HI 562/HI 462 Southern History since the Civil War (3 credit hours)
Exploration of many American "Souths" from Reconstruction to the present. How race/ethnicity, gender, class, geography, sexuality, and culture inform "Southern" identity; major political and economic changes; and the region's relationship to the nation and the world. Credit will not be given for HI 462 and HI 562.

Prerequisite: 3 hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

HI 563/HI 463 Topics in History and Memory (3 credit hours)
Explores how "collective memory" develops. Examines how memory is represented through public speeches, civic celebrations, monuments and memorials, and other forms of popular and political culture. Analyzes what is recalled, what is forgotten, and who decides. Asks why memory is made public. May be repeated once for credit when offered with a different topic. Credit will not be given for both HI 463 and HI 563.

Typically offered in Fall, Spring, and Summer

HI 566 Readings in Native American History (3 credit hours)
Readings in the varied historical experiences of nations native to North America from the first migrations of peoples into the continent until the present, including the variety and diversity of native cultures and experiences; native resistance to colonialism, expansion, and U.S. federal policies; and the survival and continuity of native cultures and peoples through more than four centuries of contact, conquest, and change.

HI 568/HI 468 Slavery in the Americas (3 credit hours)
Exploration of the development of chattel slavery throughout the Americas. Analysis of the emergence and development of New World slavery in ways that encourage students to think critically about the historical processes of abolition, emancipation, and freedom across the Atlantic world. The lectures and readings seek to dislodge the notion that the "history of slavery" only pertains to the United States. The course, instead, emphasizes commonalities and differences in ways that challenge assumptions that the institution was exceptional in any given region. Credit will not be given for both HI 468 and HI 568.

Prerequisite: 3 Hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 569/HI 469 Latin American Revolutions (3 credit hours)
Comparative analysis of causes, participants, process, and outcome of revolutions in Mexico, Bolivia, Cuba, and Central America. Credit for both HI 469 and HI 569 will not be given

Prerequisite: 3 Hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 570/HI 470 Exploring World History (3 credit hours)
Introduction to the methods, themes, and narratives of world history. As a distinct approach to historical study, world history focuses on dynamic connections and relationships among regions of the world and the variety of global processes - related to trade, religion, production, consumption, migration, imperialism, disease, and technologies - that connected them. The course is a suggested elective for future teachers who will teach world history in high school, as well as an ideal course for History majors and graduate students who want to explore the connections among all the regionally specific upper division courses they have taken. Credit will not be given for both HI 470 and HI 570.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 571/HI 471 Revolutionary China (3 credit hours)
China 1900 to present. Examination of political, cultural, and socio-economic revolutionary phases of China's 20th-century transformation from traditional empire to communism. Particular attention to post-1949 problems of nation-building. Credit will not be given for both HI 471 and HI 571

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 572 The Rise of Modern Japan, 1850-Present (3 credit hours)
Japan's emergence as a modern nation and world power. Topics include nation-state formation; modernization and its dislocations; democratization and authoritarianism; imperialism, international politics, and war; postwar reforms; changing gender relations; popular culture; and social problems. Credit will not be given for both HI 472 and HI 572

Prerequisite: Graduate standing
Typically offered in Spring only

HI 573/HI 473 Japan's Empire in Asia, 1868-1945 (3 credit hours)
An advanced survey of Japanese relations with Asia in the nineteenth and twentieth centuries. Structures and ideologies of imperialism and colonialism; modernization, nationalism and social change; migration and mobility; resistance and collaboration; and legacies of empire. Credit will not be given for both HI 473 and HI 573

P: 3 hrs. of History
GEP Global Knowledge
Typically offered in Fall only

HI 575/AFS 575/HI 475/AFS 475 History of the Republic of South Africa (3 credit hours)
Evolution of the Republic of South Africa's society, with emphasis on the interaction of diverse peoples and cultures. Particular attention is given to the period since 1870. Credit will not be given for both HI (AFS) 475 and HI 575.

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Fall and Spring

HI 576/AFS 576/HI 476/AFS 476 Leadership in Modern Africa (3 credit hours)
Recent sub-Saharan African political history (excluding South Africa). Overview of concepts, vocabulary, historical trends. Detailed examination of specific African countries as case studies, such as Ghana, Nigeria, Zimbabwe, Tanzania. Credit will not be given for both HI (AFS) 476 and HI 576.

Prerequisite: 3 hours of history
GEP Global Knowledge

HI 578 Islam and Christianity in Sub-Saharan Africa since the 19th Century (3 credit hours)
Expansion and interaction of Islam and Christianity in sub-Saharan Africa in the nineteenth and twentieth centuries, and their influence and impact on the economy, politics, and society. Topics include missionary activity, resistance to imperial authority, the role of the churches, and the influence of religion on leadership, education, nationalism, and post-colonialism. Credit will not be given for both HI 478 and HI 578; graduate standing for HI 578.

Typically offered in Fall only

HI 579/AFS 579/HI 479/AFS 479 Africa (sub-Saharan) in the Twentieth Century (3 credit hours)
Developments in sub-Saharan Africa during the colonial period, from the end of the nineteenth century to the advent of decolonization in the early 1960s. Interplay of political, social, economic and cultural factors in the experiences of African peoples during this period. Credit will not be given for both HI (AFS) 479 and HI 579

Prerequisite: 3 hours of History
GEP Global Knowledge
Typically offered in Spring only

HI 581/HI 481 History of the Life Sciences (3 credit hours)
Historical context of the individuals, ideas, scientific practices, and social goals that created the core concepts of the modern biological sciences, from Renaissance medicine to molecular biology, with a focus on interconnections of the scientific knowledge and perspective of the life sciences with other aspects of culture, including other sciences, views about nature and life, religious belief, medical practice, and agriculture. Topics include the development of biological experiments; theories of ecology and evolution; the chemical understanding of health, food, and drugs; and the modern molecular revolution. Credit will not be given for both HI 481 and HI 581.

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 582/HI 482 Darwinism in Science and Society (3 credit hours)
Scientific development of Darwinism and its reception by the scientific community and the general public. Social impact of theories of evolution as reflected in Social Darwinism, eugenics, sociobiology, and relationship of sciences to ethics and religion. Credit will not be given both for HI 482 and HI 582

P: 3 hrs. of History
GEP Interdisciplinary Perspectives
Typically offered in Spring only

HI 583/HI 483 Science and Religion in European History (3 credit hours)
Are science and religion inherently in conflict with each other? Historical analysis of the idea of the Â¿warfare between religion and science,Â¿ treating their complex relationship and respective cultural authority before 1800, including the relationship of science and religion in Europe during periods of the Reformation, the creation of early modern states, and the Enlightenment of the 1700s. Topics include visions of nature and utopias, the creation of mechanistic science in the 1600s, and natural theology. Credit will not be given for both HI 483 and HI 583.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives

HI 584/HI 484 Science in European Culture (3 credit hours)
The role of science in shaping early modern European identity, culture and polity in the 1600s and 1700s. Drawing on documents and material culture, topics include the meaning of natural wonders, explorations, travel literature, instruments and mapping, colonies and empire, and universal expos. Credit will not be given for both HI 484 and HI 584.

P: 3 hrs. of History
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HI 585/HI 485 History of American Technology (3 credit hours)
Technology in American history: the ideological, social, economic, and institutional contexts of technological change from the 1760's to the present. Impacts of new technological systems. Credit will not be given for both HI 485 and HI 585.

Prerequisite: 3 hours of History
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HI 586/HI 486 Science and Empire (3 credit hours)
The development of European science in the context of world exploration, global commercial expansion, local knowledge, and visions of colonization and empire. Credit will not be given for both HI 486 and HI 586.

Prerequisite: 3 hours of History
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

HI 587/ANT 587 Cultural Resource Management (3 credit hours)
Theoretical and practical overview of U.S. federal and state laws, institutions, and practices related to the inventory, evaluation, preservation, protection, and overall management of cultural resources; history and philosophical bases of Cultural Resource Management (CRM); professional ethics; indigenous and other stakeholder interests in CRM; and comparative national regulations outside the U.S. and the international heritage management and organizations. Graduate standing in history required.

Typically offered in Spring only

HI 588/HI 488 Family and Community History (3 credit hours)
Theory and research in family history, local history, and community studies, as well as application to public history presentation and community development. Students cannot receive credit for both HI 488 and HI 588.

P: Graduate Standing
Typically offered in Fall only

HI 589 Interpretation in Historic Sites and Parks (3 credit hours)
Methodologies of interpreting history at historic sites and parks; training in interpretive tools linking historiography and research methodology with real places for presentation to the public; considerations of practical application. Five day trips required. Graduate standing or NDS.

Requisite: NCSU Graduate Students (MR or DR), NDS Students Only
Typically offered in Spring only

HI 591 Museum Studies (3 credit hours)
Organization and operation of museums as historical agencies. Role of museums in historical research and education. Graduate standing or NDS.

Typically offered in Fall only

HI 593 Material Culture (3 credit hours)
Current theories of material culture analysis and their application to history museums. Graduate standing or NDS.

Typically offered in Spring only

HI 594 Cultural Heritage (3 credit hours)
Use of the past and its cultures in reinforcing identities. Global development of heritage preservation, cultural resource management, and heritage tourism. Role of heritage professionals in identification, study, assessment, preservation, interpretation, management, and promotion of historic and cultural resources. Law and regulations that protect and preserve cultural resources. Graduate standing or NDS.

Typically offered in Fall only

HI 595 Special Topics in History (1-6 credit hours)
Topical courses or experimental course offerings in advanced historical study.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

HI 596 Introduction To Public History (3 credit hours)
Historical origins of public history, applications of history to public life, historiography and major paradigms in the field, and debates about the public role of historians. Graduate standing in History.

Typically offered in Fall only

HI 597 Historiography and Historical Method (3 credit hours)
Major steps in development of historical investigation; analysis of elements of historical research; discussion of methodology and archival materials used by contemporary scholarly historian.

Typically offered in Fall only

HI 598 Historical Writing (3 credit hours)
Critical studies in the methods and practice of contemporary historical writing.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

HI 599 Independent Study (1-3 credit hours)
Individualized study conducted under supervision of graduate faculty. Course of study, assigned readings, course projects or papers, and methods of evaluating work to be detailed in writing and approved by department head.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

HI 642 Internship In Public History (3 credit hours)
Supervised internship experience with a public or private historical agency or institution or local, regional, or national significance. Graduate standing in History.

Typically offered in Fall, Spring, and Summer

HI 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Spring only

HI 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

HI 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

HI 787 African American Public History (3 credit hours)
Issues in public history practice as they relate to the collection, preservation, and interpretation of African American cultural history. Graduate standing in history required.

Typically offered in Spring only

HI 788 Native American Public History (3 credit hours)
Issues in public history practice as they relate to the collection, preservation, and interpretation of Native American history. Graduate standing in history required.

Typically offered in Fall only

HI 789 Public History in International Context (3 credit hours)
Global public history since 1945, including functions of historical memory as they relate to global economics of public history, world heritage, and the transnational contexts for the work of historians.

Typically offered in Spring only

HI 791 Colloquium in Public History (3 credit hours)
Advanced historiographical readings on major topics in public history. Graduate standing only.

Typically offered in Spring only

HI 792 Colloquium in History (3 credit hours)
Advanced historiographical readings on major topics in history. May be repeated for credit with different topic. Graduate standing in History only.

Typically offered in Fall and Spring

HI 795 Special Topics (1-6 credit hours)

HI 799 Independent Study (1-3 credit hours)
Independent Study

Typically offered in Fall and Spring

HI 885 Doctoral Supervised Teaching (1-3 credit hours)

HI 889 Doctoral Dissertation Seminar (1 credit hours)
Development of a solid dissertation structure, research strategy and drafting of framing chapters, preparation of dissertation proposal and proposal presentation, strategies for revision of dissertation. Three consecutive semesters beginning in semester of exams. Graduate standing in history only.

Typically offered in Fall and Spring

HI 895 Doctoral Dissertation Research (1-9 credit hours)
Typically offered in Fall and Spring

HI 896 Summer Dissert Res (1 credit hours)
Typically offered in Summer only

HI 899 Doctoral Dissertation Preparation (1-3 credit hours)

History of Art (HA)

HA 201 History of Art from Caves to the Renaissance (3 credit hours)
Art from prehistory through Ancient Greece and Rome through Italian Renaissance. Major art forms of painting, sculpture, and architecture, and how they reflect their historical context.

GEP Visual and Performing Arts
Typically offered in Fall only

HA 202 History of Art From the Renaissance Through the 20th Century (3 credit hours)
Art from the Northern Renaissance in Europe through the 20th century in Europe and America: painting, sculpture and architecture recent mixed media techniques such as collage, and trottage.

GEP Visual and Performing Arts
Typically offered in Spring only

HA 203 History of American Art (3 credit hours)
A history of American Art (painting, sculpture and architecture) from the Colonial Period through the 20th century.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

HA 240/HI 240 Introduction to Visual Culture (3 credit hours)
Introduction to the role of visual cultural production in the nineteenth and twentieth centuries in expressing and shaping both individual and collective identities. Case studies of imperialism, gender, and war draw from different regional histories and utilize a variety of visual genres - such as photography, popular posters, painting, advertising, and film stills - to study how visual culture can be used as evidence to understand the past, using the approaches of the disciplines of History and Art History.

Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

HA 298 Special Topics in Art History (3 credit hours)
Special topics in art history with emphasis on chronological periods such as 20th-century art of the Italian Renaissance or on fields of art such as paintings, sculpture, photography, or architecture.

Typically offered in Fall, Spring, and Summer

HA 395 History of Art: Study Abroad (3 credit hours)
Topical History of Art courses taught in NC State Study Abroad programs. (Current listings available in History Department, Study Abroad Office and CHASS Dean's Office.)

Typically offered in Fall, Spring, and Summer

HA 401 19th Century European Art from Revolution to Post-Impressionism (3 credit hours)
From the politically charged art of the French Revolution, through Neo-classicism, Romanticism, Realism, Impressionism and Post-Impressionism, this course examines styles, subject matter and cultural context of the many, rapid artistic changes in the long 19th century.

Prerequisite: HA 201 or HA 202
GEP Visual and Performing Arts
Typically offered in Fall only

HA 404 Italian Renaissance Art and Material Culture (3 credit hours)
From villas to teaspoons, this course investigates daily life in Renaissance Italy, 1300-1550, through the architecture, painting, sculpture, and art objects that people commissioned and used. Works of art will be analyzed in terms of style, subject matter, and historical context.

Prerequisite: 3 hrs. of HA
GEP Visual and Performing Arts

HA 410 History of the Art of Photography (3 credit hours)
History of and the interaction between art and photography from the invention of photography to the present.

Prerequisite: 3 Hours of History of Art, Film, History, or Literature
GEP Visual and Performing Arts
Typically offered in Spring only

HA 498 Independent Study in History of Art (1-6 credit hours)
Directed independent study of topics in the History of Art. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: 3 hours History of Art
Typically offered in Fall and Spring

Honors (HON)

HON 202 Inquiry, Discovery, and Literature (3 credit hours)
A study of works of literature that treats the themes of inquiry and discovery--its risks, its creativeness, its ambiguities and complexities, and its moral dilemmas--through selected works from literature and other media, including theater, music, visual arts, and film. Analysis of each work in terms of its historical context and internal structure as well as its treatment of the nature of inquiry and discovery.

R: Honors or Scholars
GEP Humanities
Typically offered in Fall, Spring, and Summer

HON 290 Honors Special Topics - Humanities/US Diversity (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GEP requirements in Humanities and US Diversity co-requisite. Interdisciplinary in character and often team-taught.

Restricted to students in the University Honors Program. Other students upon approval.
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

HON 291 Honors Special Topics-Mathematics (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in mathematics, interdisciplinary in character and often team-taught.

Prerequisite: HON student
GEP Mathematical Sciences
Typically offered in Fall and Spring

HON 292 Honors Special Topics-Natural Sciences (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the natural sciences, interdisciplinary in character and often team-taught.

Prerequisite: HON student
GEP Natural Sciences
Typically offered in Fall and Spring

HON 293 Honors Special Topics - Interdisciplinary Perspectives/ Global Knowledge (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GEP requirements in Interdisciplinary Perspectives and and Global Knowledge co-requisite. Interdisciplinary in character, and often team-taught.

R: Honors or Scholars
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 294 Honors Special Topics-Humanities (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the Humanities, and interdisciplinary in character.

Prerequisite: HON student
GEP Humanities
Typically offered in Fall and Spring

HON 295 Honors Special Topics-Social Science (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in the social sciences, interdisciplinary in character, and often team-taught.

R: Honors or Scholars
GEP Social Sciences
Typically offered in Fall and Spring

HON 296 Honors Special Topics - Interdisciplinary Perspectives (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Interdisciplinary Perspectives.

R: Honors or Scholars
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 297 Honors Special Topics - Interdisciplinary Perspectives/US Diversity (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GEP requirements in Interdisciplinary Perspectives and US Diversity co-requisite. Interdisciplinary in character and often team-taught.

R: Honors or Scholars
GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall and Spring

HON 298 Honors Research/Independent Study (1-3 credit hours)
Research/independent Study for University Honors Program students. Repeatable if content differs. Research or independent study under supervision of faculty members. Project approval by the Honors Program Advisory Committee necessary prior to registration. Permission of the University Honors Program required. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

HON 299 Honors Special Topics - Visual and Performing Arts (3 credit hours)
Seminar for University Honors Program students, repeatable if content varies, meeting GER requirements in Visual and Performing Arts, interdisciplinary in character and often team-taught.

R: Honors or Scholars
GEP Visual and Performing Arts
Typically offered in Fall and Spring

HON 300 Race, Membership, and Eugenics (3 credit hours)
Theories of race are linked to eugenics, a belief and practice of improving the genetic quality of the human population drove much of American social policy in the early 20th century. The practice and science that supports it has historical roots in the US and in particular for poor people and people of color. This course will examine race, membership, and eugenics and the impact on American society, as well as explore the scientific and social trends that supported the movement. Course restricted to University Honors Program Students; others by permission of the UHP.

R: University Honors Program Students; others by permission of the University Honors Program
GEP U.S. Diversity
Typically offered in Fall and Spring

HON 310 The Creative Process in Science: Realities, Comparisons, and Culture Perceptions (3 credit hours)
What is creativity in the context of the sciences? How does the creative process in science differ from and how is it similar to the creative process in other fields? This interdisciplinary perspectives course helps students to develop an understanding of scientific creativity through readings in history and philosophy of science, in the psychology of creativity, in original scientific papers, in biography and in memoirs. Student will analyze representations of scientific creativity in films and literature, conduct interviews with scientists, artists, musicians, and humanists, and analyze the social and institutional context of creativity.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

HON 311 Words through Space and Time (3 credit hours)
Cultures differentiate and frame events in various ways. At the heart of conceptual events are WORDS: an inventory of the ways a particular group of people depict and understand the interactions they have with each other and with the world around them. Through a detailed examination of lexical phenomena in cultures around the world, we will become familiar with the ways in which language and culture interact, the extent to which these surface in our everyday lives and the explanations proposed by various fields for their existence.

GEP Global Knowledge, GEP Interdisciplinary Perspectives

HON 312 Outbreak (3 credit hours)
Students will evaluate disease outbreaks from multiple different perspectives, including the biology of the infectious agent, clinical implications, and social/economic/political factors contributing to the spread of the disease or that were impacted by a major epidemic/pandemic. This course will be inquiry-guided. The instructor will not generally be "presenting material", but rather providing the structure in which students will be guided to investigate the issues from multiple perspectives through the use of case studies, primary and secondary literature, student-driven research and presentations, and concept mapping.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

HON 313 Reading Machines (3 credit hours)
This course invites first-year students into a historically ranging, critically intensive, and hands-on learning environment about the technologies by which humans transmit our cultural inheritance and ideas. "Reading Machines" takes a long view of how we got to now, from the history of manuscripts and books to the electronic platforms of the digital present. These are all machines of reading; in turn, this class will "read" those machines as objects of study. The course proposes that 1) then and now, our technologies for sharing text, image, and data crucially shape the ideas which they convey, and 2) these contexts can help students plan and execute new mechanisms for communication in the present. The course's modules offer critical frameworks of background readings and discussions, a lab-like experience with the materials or skills involved, and applied projects for students to experiment with and study.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 314 Society's Mirror: Literature in 20th-Century America (3 credit hours)
This course looks at several key works of twentieth-century American literature and asks what they reveal about the society in which they were produced. In honor of the beginning anew of the 20s, the first half of our class will consider the many ways literature in the Jazz Age represented and critiqued the era - from stories published in popular magazines, which find their modern-day equivalent in streaming services, to authors of the Harlem Renaissance. The second half of the class will take us to the second half of the century, where we will consider how authors like Ken Kesey, Shirley Jackson, and Margaret Atwood reveal and challenge prevailing conformity. To continue with our metaphor, the frame for our mirror will consist of the social, cultural, and material contexts in which these works were published, understood, and interpreted.

R: Honors or Scholars
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

HON 340 Religion and Freedom (3 credit hours)
For a variety of reasons, "religion" is one of the most controversial subject matters in contemporary cultures. Beyond sensationalism and outrage, though, modern societies have taken shape in part through complex debates about the role (or lack thereof) of religion in public life. At the core of these considerations are clashing understandings of the relation between religion and freedom, two broad categories with a range of different meanings. This course will explore these differing understandings by considering: legal arguments proposing freedom of religion, and the challenges of religious pluralism; arguments urging freedom from religion, in defense of secular public life; and invocations of freedom through religion, via human creative expression, social activism, ritual, or cosmology. We will examine not just scholarly writings about religion but literature, films, and other media that have shaped the ongoing conversation.

R: University Honors Program Students; others by permission of the University Honors Program
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HON 341 Time Travel (3 credit hours)
A study of contemporary metaphysics organized around the topic of time travel. David Lewis, perhaps the foremost contemporary metaphysician, argues that time travel is possible. His argument is based on ingenious positions about three central topics of metaphysics, personal-identity, causation, and free will. Students will consider each of these topics in some detail, always with an eye to their implications for time travel.

Prerequisite: HON student
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

HON 344 Kantian Ethics (3 credit hours)
In this course students will be introduced to foundations of morality by exploring one of the most significant moral theories in the history of philosophy, Kantian ethics. The course will focus on Kant's ideas about morality and discuss his proof of the fundamental principles of ethics. Students will be introduced to some of the enduring moral questions, such as What ought I to do? What can I hope? Are there universal moral principles and whether I ought to follow them? They will learn a variety of approaches to ethical issues and their reflection in social and political reality.

GEP Humanities
Typically offered in Spring only

HON 345 On the Human (3 credit hours)
Students in this seminar course actively explore human singularity: the properties, if any, that distinguish persons from animals and machines. Do we have souls? To what extent can we give physical explanations of our thoughts and actions? What, if anything, do scientific experiments tell us about our differences from chimps and artificial intelligences? What are the ethical implications of new biotechnologies? Should we be allowed to use genetic and neural engineering to change human nature? Students read articles, watch videos, stimulate class discussions with prepared questions, write short essays and a final paper, and participate in a 60-minute team presentation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 347 Freedom and the Self (3 credit hours)
This course explores the complex and interrelated concepts of freedom and the self. The bulk of our time will be devoted to a close reading of several philosophical texts in which these concepts loom large. The course ends with a careful examination of three novels that, in various ways, take up the central themes of the class. Our intention in doing so is to reflect on the way that imaginative novelists treat these themes. This will enable us to ask broader and more interesting questions about freedom and selfhood.

R: University Honors Program Students; others by permission of the University Honors Program
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

HON 348 Emotion and Reason (3 credit hours)
Consider the range of emotions that one experiences in a lifetime, from the joy of being with your loved ones to the fear of losing them, from the thrill of success to the sadness of defeat. Pleasant or aversive, emotions play a central role in our lives. Despite their obvious importance, emotions have been considered by many philosophers to be inferior to another distinctive faculty in human beings, namely reason. The idea that emotions are primitive, irrational and dangerous and thus to be controlled and constrained by reason has been embraced by eminent thinkers from Plato and the Stoics to Kant. In this course, we will focus on the relationship between reason and emotion in moral cognition and cognition more generally, and we will investigate how/to what extent reason can be said to be distinct from and superior to emotion.

Restriction: University Honors Program students. Open to other students by permission of the UHP.
GEP Interdisciplinary Perspectives
Typically offered in Fall only

HON 352 Self, Schooling, and the Social Order: A Critical Examination (3 credit hours)
What is the purpose of schooling? What role does it play in producing particular types of citizens and social structures? Theorists have imagined education as a space for democracy, as a way to cultivate identity, or as a method to train workers. All of these imaginaries attempt to understand interrelationship between the self, schooling, and the social order. This course will survey major social theories and, within the context of those theories, encounter texts which examine how schooling serves to maintain or subvert the social order. Course restricted to University Honors Program students; others by permission of the UHP.

GEP Social Sciences, GEP U.S. Diversity

HON 353 Code Breakers: Unlocking the Mysteries of One Human Language (3 credit hours)
This course will introduce you to the architecture of one language. Students will work from scratch with a speaker of a language that none of us know, with the goal of unlocking the mysteries of that language at all levels - sound system, word formation, sentence structure, semantics and pragmatics. You will learn how to elicit field data through direct questioning and gathering of texts, how to organize field data, how to prepare entries in a field dictionary, and how to organize and write grammar. Course restricted to University Honors Program students; others by permission of the UHP.

GEP Global Knowledge, GEP Social Sciences

HON 354 The Winners and Losers of U.S. Agricultural Policy (3 credit hours)
This course explores the history and unintended consequences of U.S. (and international) agricultural policy. We will develop tools to assess the logical, objective, and critical analysis of agricultural policies. Every policy intervention involves winners and losers and your objectives will be to identify and evaluate how welfare is affected by government intervention. Students will explain, hypothesize, or interpret a disciplinary issue, based on critically analyzed evidence. Current events will be emphasized and students will investigate how trade tensions between the U.S. and other countries often result in retaliation against U.S. agriculture. Grades will be based on student presentations, debates, class participation, and a final policy paper.

R: Honors or Scholars
GEP Social Sciences
Typically offered in Fall and Spring

HON 355 Feelings of/from Technology: Analog Bodies in Digital Spaces (3 credit hours)
While we live in a Digital Age, we have only begun to understand its full significance. What new possibilities arise in a virtualized future? Can we escape scarcity, this planet, even death? What problems might our technologies solve? Modern technologies also raise new existential challenges: Why has the increased prosperity that technologies provide been met with seemingly impoverished and unhappy lives, loneliness, and alienation? How does technology mediate our sense of identity and the relations we have with society, nature, and ourselves? This course will explore the phenomenology of technological life - that is, the descriptive study aimed at looking at the relations between humans and our world, a technologically-mediated world. We will use this experiential and descriptive approach to consider the moral dimensions and psychological and sociological consequences of digital and emerging technologies, especially information and communications technologies (ICTs) like the internet and social media.

R: Honors or Scholars
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 356 Sweet: A Global History of Sugar (3 credit hours)
In 2015, The Washington Post reported that on average, Americans consumed 126 grams of sugar per day, more than double the amount recommended by the World Health Organization. Yet China and India, which had the earliest known mass production of sugar, consume much less. Why? Applying the overlapping theories and methodologies of cultural history and anthropology as well as other components of Food Studies, this class will explore the world travels and vicissitudes of sugar as a commodity and cultural marker. We will trace sugar's production in the first age of capitalism and its reliance on the global slave trade for production as well as the development of its rituals of consumption, in conjunction with other stimulants and intoxicants, such as chocolate, tea, and rum. We will consider the rise of the modern western obsession with sweets in comparison to other cultures, using our own experiences and observations.

R: Honors or Scholars
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

HON 360 Music and Resistance (3 credit hours)
Music and Resistance will examine how people use music both as a tool of oppression and a method of resisting oppression. Course topics will include the use of western classical music by colonial powers; music and torture; music during World War II (including the use of music in concentration camps and as propaganda in Allied and Axis countries); music in Indian Boarding Schools; music in the American Civil Rights Movement; and hip hop as the music of oppressed populations in Europe and the United States. Reading assignments will come from a wide range of sources and disciplinary perspectives including scholarly articles, book chapters, and personal memoirs. We will listen to and discuss music from multiple genres including hip hop, pop, jazz, folk, and the western classical tradition. No previous musical experience as a performer is required to be successful in this class.

R: Honors or Scholars
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HON 367 Introduction to Interdisciplinary Biomedical Teamwork (1 credit hours)
HON 367 (Introduction to Interdisciplinary Biomedical Teamwork is a special weekly seminar that will introduce students to Team Science (teamwork) and Biomedical Research. Students will be introduced to the Comparative Medicine Institute (CMI) U-STAR program, faculty mentors involved with the program and cutting-edge research associated with the program. Seminar topics will include: CMI and interdisciplinary research on campus, instructional seminars on literature searching, scientific writing, research ethics and research overviews by U-STAR training faculty.

Typically offered in Fall, Spring, and Summer

HON 390 Music and the Celtic World (3 credit hours)
In this course, students explore the diverse musics of the Celtic world, from cultural practices of the ancient Celts to folk and popular traditions of Ireland, Scotland, Wales, Brittany, Galicia, Cape Breton, and the United States. They investigate the origin and meanings of "Celtic music," and study its diverse instrumental, vocal, and dance traditions, and its varied performance practices, occasions, and purposes. Through history, literature, poetry, spirituality, and mythology, students examine the realities and fictions of the ancient and modern Celtic world. Through live and recorded music and dance performance, they consider the continuities of Celtic culture across time and space, and the significance of Celtic music today in terms of cultural identity, tradition, and globalization.

R: University Honors Program
GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Visual and Performing Arts
Typically offered in Spring only

HON 395 Honors Cooperative Education (3 credit hours)
Experimental work in government or industry for Honors Program students with two semesters completed in Honors. Typically students work 40 hrs/week with salary. Work supervisor, faculty adviser and Honors Program Director must sign HON 395 Honors Cooperative Ed contract. NC State cooperative Education requires paper work; student must pay fee rate for a 0-5 credit hour course. No other courses permitted along with HON 395. Student report of the independent project is required.

Prerequisite: Two semester full time in University Honors Program
Typically offered in Fall and Spring

HON 397 Honors Extension and Engagement (1-6 credit hours)
Opportunity for significant hands-on involvement in extension and engagement research/project as mentored by NC County Extension employees often in cooperation with community employers/executives, local and government officials, and county citizens. Approved plan of work required with significant independent research/project including a reflective journal, a final paper and presentation at the NC State Undergraduate Research Symposium or a venue appropriate to the discipline. Students must provide their own transportation.

Prerequisite: One semester good standing in University Honors Program
Typically offered in Fall and Spring

HON 398 Honors Special Topics (1-6 credit hours)
A seminar or other learning experience within an academic framework that may be on- or off-campus. Enables the development of new HON courses outside the GER list.

Typically offered in Fall, Spring, and Summer

HON 496 Honors Capstone Seminar (3 credit hours)
Honors Seminars open to Juniors and Seniors in all disciplinary Honors Programs, and others with permission of the University Honors Program. Repeatable if content differs. A series of seminars with differing subjects, interdisciplinary in character and sometimes team-taught, allowing advanced students to explore topics from a multidisciplinary perspective and to apply their knowledge to issues and problems in the present world. Permission of the University Honors Program

Prerequisite: HON student
Typically offered in Fall and Spring

HON 497 Interdisciplinary Biomedical Research Capstone (2 credit hours)
Interdisciplinary Biomedical Research (BioMR) Science Capstone Seminar. This seminar is intended to provide practical real-world engagement to integrate interdisciplinary biomedical team science teamwork, communication, and leadership. The seminar will include exploring and engaging with a science-based Common Reading where students will use leadership, communication, and team science skills to evaluate multiple aspects of team dynamics including unconscious bias. The seminar will also include active engagement opportunities in the areas of academics, government, and industry. These diverse experiential learning opportunities will further allow students to explore team science, leadership, and communication. This course will also involve an end of semester roundtable conversation and service component, all designed to reinforce the learning outcomes.

Typically offered in Fall, Spring, and Summer

HON 498 Honors Research/Creative Project 1 (3 credit hours)
Opportunity for hands-on faculty mentored research/creative project. Course may be stand-alone project completed in one semester/summer, or serve as part of a two semester project that is completed at the end of Honors Research/Creative Project 2 (HON 499). Approved plan of work required with significant independent research/creative project culminating with final paper and presentation at the NC State Undergraduate Research Symposium or other venues appropriate to the discipline. Research within or outside the student's discipline may fulfill experience. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: One semester in good standing in University Honors Program, UHP student
Typically offered in Fall, Spring, and Summer

HON 499 Honors Research/Creative Project 2 (3 credit hours)
Opportunity for hands-on faculty mentored research/creative project. Course serves as final part of a two-semester project that began with Honors Research/Creative Project 1 (HON 498)or approved disciplinary research experience. Approved plan of work required with significant independent research/creative project culminating with final paper and presentation at the NC State Undergraduate Research Symposium or other venues appropriate to the discipline. Research within or outside the student's discipline may fulfill experience. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: One semester in good standing in University Honors Program, UHP student
Typically offered in Fall, Spring, and Summer

Horticulture Science (HS)

HS 101 Introduction to Ornamentals and Landscape Technology (1 credit hours)
Introduction to the collegiate experience, academic skills of successful students, and scope, purpose, and objectives of the Agricultural Institute with an emphasis on areas related to the ornamental and landscape plants industry. Students will explore college and departmental resources, academic policies and procedure, the green industry, career opportunities, and current trends and issues in horticulture.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 111 Plant ID (3 credit hours)
Identification, adaptation, culture, and use of ornamental trees, shrubs, vines, ground covers and herbaceous plants.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 115 Plant Growth and Development (3 credit hours)
Examination of how plants grow and respond to environmental and cultural stimuli. Topics include: cell growth; flower, fruit, seed, shoot, and root development and functions; anatomy of stems, roots and leaves; hormonal regulation of growth; adaptations for survival; plant responses to temperature, light and gravity; photosynthesis, transpiration, and absorption of water and nutrients.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 121 Plant Propagation (3 credit hours)
Principles and practices involved in sexual (seed) and asexual (vegetative) propagation of a variety of plants. Methods of asexual propagation include cuttings, layering, budding and grafting, division, separation, and micropropagation (tissue culture). Emphasis on factors affecting the regeneration of species by particular techniques.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 131 Fruit & Vegetable Production (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of small-scale fruit & vegetable production in North Carolina. Agricultural Institute students only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 141 Greenhouse Crop Production (3 credit hours)
Production of greenhouse crops. Emphasis on greenhouse construction and environmental manipulation of crop growth. Site selection, construction materials, greenhouse design. Specific flowering crops as models to demonstrate potted flowering plant, cut flower, and bedding plant production systems. Hands-on crop production experience plus trips to commercial floriculture production and marketing facilities.

Typically offered in Spring only

HS 144/PP 144 Weeds & Diseases of Ornamentals (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of weed, disease, and pesticide management in the ornamental industries in North Carolina. Agricultural Institute students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 151 Nursery Production (3 credit hours)
Total aspects of field and container nursery stock production including site selection and development, propagation, growing procedures, harvesting, marketing, shipping and labor management practices.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 162 Landscape Maintenance (3 credit hours)
A study of the maintenance of landscaped areas including plant material selection, installation, pruning, fertilization, and pest control of trees, shrubs, lawns, flower beds, and interior plants.

Requisite: Agricultural Institute Only
Typically offered in Fall only

HS 171 Landscape Construction (3 credit hours)
This course will provide students a fundamental and practical understanding of landscape construction techniques and equipment. AGI students only.

Requisite: Agricultural Institute Only
Typically offered in Spring only

HS 175 Horticulture Entrepreneurial Skills for Local Markets (3 credit hours)
This course is structured to introduce students to entrepreneurship, startups and the basic principles of business administration and management with focus in the horticulture industry in local markets. The class will give students the opportunity to learn pragmatic skills and tools to start their own business or to be successful managers in local horticulture industries. Students will describe and discuss the following topics: marketing, management, accounting, finance, and the issues involved with starting and managing a small horticultural business.

Typically offered in Spring only

HS 200 Home Horticulture (3 credit hours)
Introduction and review of home horticulture as it relates to the horticultural enthusiast. A general understanding of plant growth, structure, and development; house plant selection and care, selecting trees, shrubs, and flowers for the home landscape, and other related topics. Note: this course was previously offered as HS 100.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

HS 201 The World of Horticulture: Principles and Practices (3 credit hours)
Principles of plant growth and development relating to production and utilization of fruit, vegetable, floricultural, and ornamental crops. Historical, economic, and global importance of horticultural crops and services.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

HS 202 Home Plant Identification (3 credit hours)
An introductory course developed in conjunction with Longwood Gardens on plant taxonomy, identification, characteristics, and use in the home landscape. A palette of 150 plants will be covered including identification by scientific and common names and aspects of their cultivation. Not for Horticultural Science Majors [SH, THG, THL].

Typically offered in Spring only

HS 203 Home Plant Propagation (3 credit hours)
Not for Horticultural Science Majors (SH, THG, THL). Substitution of HS 203 for HS 301 are not allowed. An introduction to the basic principles of sexual and asexual plant propagation, including seeds, cuttings, layering, Grafting, and Division.

GEP Natural Sciences
Typically offered in Spring only

HS 204 Home Landscape Maintenance (3 credit hours)
An understanding of the basic principles of landscape maintenance including, but not limited to, soil fertility and management, tree biology, pruning, turfgrass maintenance, plant selection, irrigation management and waterwise gardening, integrated pest management, and hardscape construction. Not for Horticultural Science majors (SH, THG, THL).

Prerequisite: HS 200 or HS 201
GEP Natural Sciences
Typically offered in Fall and Spring

HS 205 Home Food Production (3 credit hours)
Home food production will play an important role in increasing the sustainability of the world's food systems for the foreseeable future. The goal of this course is to familiarize students with the scientific knowledge and tried-and-true practices needed to successfully produce food at home, even in small-scale environments such as decks and patios. On-campus students will be required to participate in two Saturday field trips to visit local home gardens. Distance educations students will be required to visit two home gardens in their area. Not for Horticultural Science Majors (SH, THG, THL).

Typically offered in Fall and Spring

HS 215/ANS 215 Agricultural Genetics (3 credit hours)
To provide an introduction to the science of genetics as applied to agriculture. Emphasis is given to qualitative and quantitative genetics. By the end of this course, students should be able to apply genetic concepts to efficiently solve problems and make predictions necessary for "real-life" agricultural situations.

Prerequisite: BIO 183 or equivalent or instructor's consent
GEP Natural Sciences
Typically offered in Fall only

HS 242 Introduction to Small Scale Landscape Design (3 credit hours)
Landscape Horticulture is concerned with the small-scale design and use of plants and other materials to help humans relate better to the land. In this course, we will pursue an understanding of this relationship and explore the social, environmental, and economic implications of landscape design and the processes by which this understanding can be employed to design residential landscapes. There are an infinite number of design possibilities for each project, so it's a designer's responsibility and challenge to develop a creative and functional design that accommodates the needs of the users and is appropriate for a specific site.

GEP Visual and Performing Arts
Typically offered in Spring only

HS 250 Home Landscape Design: Creating Garden Spaces (3 credit hours)
Home landscape design is a 3-credit hour course for non-landscape design majors. Students will be introduced to the various issues associated with landscape design at the residential level. Through a series of Power Point lectures, on-line discussions, and small projects/exercises, students will gain an understanding of landscape graphics. Skills in design, and develop landscape plans and other forms of landscape graphics. Students will use all of their learned skills to develop a design for a given site using provided design software.

Typically offered in Summer only

HS 252 Landscape Graphic Communication (2 credit hours)
This class is an introduction to the basic graphic skills necessary to develop and communicate creative ideas in landscape design. In the design process, we use graphic skills to communicate our ideas, starting with analysis, moving on to concept, then to design development, and finally to illustrative renderings. The design process will be introduced and serve as a backdrop for incrementally introducing graphic skills. The class will become confident in the use of manual drawing skills, and will be introduced to the use of computer drafting skills. Graphics supplies, with an estimated expense of $120.00, are required for the course.

Prerequisite: Horticultural Science Majors
Typically offered in Spring only

HS 272 Landscape Design/Build (6 credit hours)
This course will consist of the development of design and construction projects, which will incorporate the entire design process culminating with a complete set of construction documents, cost predictions and built projects. Critical and creative thinking strategies are incorporated in teaching and learning activities. Course materials and experiences will prepare the student for further design/build experiences as well as the NC Landscape Contractor's Licensing Exam.

Prerequisite: HS 201 and HS 242
Typically offered in Fall only

HS 275 Floral Design (3 credit hours)
This course explores the history of floral design, care, handling, and identification of fresh cut flowers, the use of tools, equipment, and supplies and the application of basic design styles, and displays. Students will gain hand-on experience in creating a wide variety of floral displays and will be able to keep their arrangements. An additional fee (not greater than $200) will be assessed to your tuition bill for fresh flower supplies for the semester for this class.

GEP Visual and Performing Arts
Typically offered in Fall only

HS 280 Hands-On-Horticulture (3 credit hours)
This course will provide students a fundamental and practical understanding of applied techniques in horticulture. Students will learn basic hardscape construction, basic wooden landscape structure construction, vegetable harvest, propagation of perennial plants, principles of irrigation installation, safe and efficient use of landscape equipment including arboriculture, and professional certification and licensing. Pesticide Licensing Fee of $75 required.

Typically offered in Summer only

HS 290 Horticulture: Careers and Opportunities (1 credit hours)
Introduction and orientation to programs in horticultural science. Discussion of the current status of horticulture, extension and research. Emphasis on undergraduate program management, internships, graduate education, and career planning. Guest lectures, career opportunities and qualifications for employment in horticulture and related fields.

Typically offered in Fall only

HS 301 Plant Propagation (4 credit hours)
Theoretical basis and techniques for successful asexual and sexual propagation of seed plants and ferns. Influence of heredity, phytopathological infection, and environmental conditions on success and quality of propagules. Recent developments and innovations in propagation techniques and methodologies.

Prerequisite: BIO 181 or BO 200
GEP Natural Sciences
Typically offered in Fall only

HS 302 Gardening with Herbaceous Perennials (3 credit hours)
Examination of the use of herbaceous perennials in the home garden and commercial landscapes. Topics include: general plant characteristics, culture and management, garden attributes, design usage, horticultural history, propagation, use of exotic (nonnative)species in the garden, heirloom roses and ornamental grasses.

Prerequisite: BIO 183 or BO 200
Typically offered in Spring only

HS 303 Ornamental Plant Identification I (3 credit hours)
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasis on bedding plants, trees and gymnosperms.

Prerequisite: BIO 181
GEP Natural Sciences
Typically offered in Fall only

HS 304 Ornamental Plant Identification II (3 credit hours)
Identification, distribution, growth, characteristics, adaptation, and usage of ornamental plants. Emphasizes shrubs, ground covers, and vines.

Prerequisite: BIO 181
GEP Natural Sciences
Typically offered in Spring only

HS 357 Landscape Grading and Drainage (4 credit hours)
This course is an introduction to landforms, site grading and drainage, and the manipulations of such landforms necessary to create built landscapes. Site design, site development, and site engineering all refer to the process of grading and drainage. Grading and drainage are processes used to reshape the earth's surface and to convey surface water runoff.

Prerequisite: Landscape Horticulture (11HORTTHL) students, HS 242 and 252
Typically offered in Spring only

HS 400 Residential Landscaping (6 credit hours)
Equips students with the necessary skills to create functional, aesthetic, and humanistic designs for residential and other small scale projects. Aspects of problem identification, project organization, design, execution, and evaluation. Required field trip with fee.

Prerequisite: HS 242, HS 252, HS 303, HS 304, and HS 357
Typically offered in Spring only

HS 410/CS 410 Community Food Systems (3 credit hours)
This course explores the economic, socio-cultural, policy and health perspectives of community food systems using a multidisciplinary and systems-level framework. Students will use a systems framework to critically examine local and global food challenges related to food insecurity, food justice and food sovereignty, food waste and sustainable approaches to addressing food challenges. Novel aspects of this course include student experiential learning opportunities that include service learning with community partners addressing local food challenges, team building through group work and in-class discussion and development of personal food ethic provocative proposition.

Prerequisite:Junior or senior standing
Typically offered in Fall only

HS 411 Nursery Management (3 credit hours)
Principles and practices of production, management, and marketing of field-grown and container-grown nursery plants. One of three scheduled weekend field trips required at students' expense.

Prerequisite: BIO 181, SSC 200, Junior standing
Typically offered in Fall only

HS 416/HS 516 Planting Design (4 credit hours)
Developing and cultivating a design process for creating meaningful and compelling ornamental planting designs through the study and practice of spatial articulation (form, enclosure, permeability), physical properties of plants (line, form, texture, color), client/site analysis and program development, visual journaling, garden narrative, presentation skills, utilizing principles of visual composition, design communication, and understanding and resolving technical and horticultural issues in contemporary planting design.

Prerequisite: Landscape Horticulture (11HORTTHL) concentration, HS 400
Typically offered in Fall only

HS 418 Digital Media Graphic for Landscape Designers (3 credit hours)
Digital media is used in the landscape design profession as a tool with analytic, expressive, and representational abilities. The course focuses on introducing landscape design students to digital representational tools used to communicate design ideas for small scale landscape design projects. Students will be introduced to techniques used in AutoCAD, Photoshop, Illustrator, InDesign, and Sketch Up modeling programs. Digital representation will be used to develop the variety of images necessary to explore and communicate design intentions. Materials for this course will cost approximately $50.

Prerequisite: HS 242 and HS 400
Typically offered in Fall only

HS 420/HS 520 Green Infrastructure (3 credit hours)
Green infrastructure is defined as the interconnected networks of natural and constructed ecological systems within and in-between urban areas. When implemented in a holistic way, green infrastructure can provide benefits at the residential, neighborhood, community levels providing for greater health and well-being, an improved functional environment, and a thriving dynamic economy. Well-designed urban landscapes offer significant economic and social benefits that directly improve the urban environment for people, plants and animals- from increasing real estate value and reducing energy costs, to enhancing health and food security, and providing habitat for a diverse population of animals and plants. Since addressing environmental issues requires a multidisciplinary approach, this course is designed for any student with interests in horticulture, biological engineering, landscape architecture, environmental sciences, urban forestry, and any others who care about the sustainability of their communities.

Typically offered in Fall only

HS 421/HS 521 Temperate-Zone Tree Fruits: Physiology and Culture (3 credit hours)
Physiology and culture of the major temperate-zone tree fruit and nut crops of the United States. Fundamental principles underlying woody plant growth as applied to the culture of specific tree-fruit crops with emphasis on crops of commercial importance to North Carolina.

Prerequisite: BIO 181 or B0 200
Typically offered in Spring only

HS 422 Small Fruit Production (3 credit hours)
Importance and economic value of blackberries, blueberries, cranberries, grapes, raspberries, strawberries and minor small fruit crops in the agricultural economy of the USA and the world. Cultural requirements of these crops and manipulation of their known morphological and physiological traits for successful production. Six all afternoon field trips are required.

Prerequisite: BIO 181, SSC 200, HS 201
Typically offered in Spring only

HS 423/HS 523 Viticulture (3 credit hours)
A presentation of the commercial importance, distribution, anatomy, physiology, and production of Genus Vitis (grapes) including cultivars, propagation, canopy management, diseases, weed control, physiology, anatomy, irrigation, wine production, climates and soils. This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities IS required for this class

Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

HS 428/SSC 428 Service-Learning in Urban Agriculture Systems (1 credit hours)
Course provides students a hands-on experience in urban agriculture with under-served youth in the Raleigh area. Students partner with a community gardening organization to provide knowledge and experience in soil science and agriculture to youth with the goals of increasing urban food security and developing student leadership skills. Particular emphasis is places on reflecting on course activities and deepening of skills related to extension, outreach, and working with diverse populations. Course designed to be taken as a companion course to SSC 427, however can be taken as a stand-alone course.

Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
GEP U.S. Diversity
Typically offered in Spring only

HS 431 Vegetable Production (4 credit hours)
Principles and practices of production and marketing of seventeen vegetable crops grown in the U.S. Additional topics include pest management, seed technology, food safety, sustainable agriculture, use of genetically engineered crops, and consumer issues.

Prerequisite: BIO 181, SSC 200
Typically offered in Fall only

HS 432/HS 532 Introduction to Permaculture (3 credit hours)
Permaculture means "permanent culture," and ..."is the conscious design and maintenance of cultivated ecosystems that have the diversity, stability, and resilience of a natural ecosystem." [Bill Mollison] This course will explore a design/thinking methodology that seeks to provide our essential physical needs, food, water, shelter, energy, etc., while doing so in an environmentally friendly, sustainable manner. This course is restricted to upper level undergraduate, graduate, or matriculated continuing education students. STUDENTS MAY NOT RECEIVE CREDIT FOR BOTH HS 432 AND HS 532.

Typically offered in Fall and Summer

HS 433/HS 533 Public Garden Administration (3 credit hours)
This course addresses the practices, programs, and professional skills that are critical to the successful management of public gardens. The aim of the course is to better prepare graduate students and upper-level undergraduates for potential careers in public garden administration. Topics will include a brief history, impact, and current trends of public gardens in the United States; plant collections; managing staff, volunteers, and boards, and the visiting public; finances and fund raising; educational programming; visitor services; and careers in public gardens. Two Saturday off-campus field trips are required.

Typically offered in Fall only

HS 440 Greenhouse Management (3 credit hours)
Perspective of greenhouse systems management. Selection of greenhouse site, construction, heating, cooling and production systems. Emphasis on greenhouse operations, cost accounting and analysis. Other topics; root substrates, sanitation, water, fertilization, chemical growth regulation, temperature, light and marketing. Hands-on experience in greenhouse operations plus trips to commercial greenhouses and markets.

Prerequisite: SSC 200 and HS 201
Typically offered in Fall only

HS 442 Floriculture Crop Production (3 credit hours)
Production of floricultural crops. Emphasis on environmental manipulation and scheduling of crop growth and development for targeted market periods. Specific flowering crops as models to demonstrate potted flowering plant, cut flower, and bedding plant production systems. Hands-on crop production experience plus field trips to commercial floriculture production and marketing facilities.

Prerequisite: SSC 200, HS 201
Typically offered in Spring only

HS 451/HS 551 Plant Nutrition (3 credit hours)
An understanding of the basic mineral nutrient requirements, nutritional monitoring procedures, and fertilizer application methods in horticultural production systems including those for fruits, field vegetables, fruits and vegetables under plasticulture, nursery crops, landscapes, greenhouse flowers and vegetables, interior plantscapes, hydroponics, and organic farming.

Prerequisite: SSC 200
Typically offered in Spring only

HS 462/HS 562/FS 562/FS 462 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

HS 471 Landscape Ecosystem Management (4 credit hours)
Well-designed, installed, and maintained urban/suburban ecosystems offer significant economic and social benefits that directly improve the environment for people, plants and animals. Learn how to select, install and maintain plants as part of a sustainable landscape. This course provides students with the tools to understand and implement landscape ecosystem management techniques that include, but are not limited to plant selection and maintenance, soil maintenance and renovation, thoughtful application of common landscape chemistry and IPM, urban/suburban wildlife conservation (including plant pollinators), and installation and promotion of green infrastructure practices.

Prerequisite: SSC 200
Typically offered in Fall only

HS 475 Horticulture Entrepreneurship (3 credit hours)
This course is structured to introduce students to entrepreneurship, startups and the basic principles of business administration and management with focus in the horticulture industry in a global context. The goal of this class is to give students pragmatic knowledge and tools to start their own business or to be successful managers in the horticulture industry. Students will describe and discuss the entrepreneurial thinking process and as they analyze the following business topics: marketing, management and leadership, accounting, and finance.

Typically offered in Spring only

HS 476/HS 576 Crop Physiology and Production in Controlled Environments (3 credit hours)
This course focuses on plant eco-physiological responses to different environmental factors such as: light intensity, quality, duration and penetration; CO2 diffusion; thermodynamic properties of moist air; root environment; air dynamics; water relations; and canopy energy balance. In addition, the course emphasizes the application of controlled environment technologies to manipulate crop responses. The laboratory is designed to optimize the production of edible crops in greenhouses and vertical farms by applying the foundational knowledge of plant eco-physiology in combination with advance controlled environment technologies.

Prerequisite: PB 321 or PB 421 and either MA 114 or MA 121 or MA 131 or MA 141
Typically offered in Spring only

HS 480/CS 480 Sustainable Food Production (capstone) (1 credit hours)
This course introduces students to the process of developing a project for presentation in the area of sustainable food production and food systems. Students are to synthesize and integrate knowledge acquired in previous course work and other learning experiences and to apply theory and principles in a situation that approximates some aspect of professional practice. Students are expected to present their projects at the end of the semester in a PowerPoint style format to faculty and student peers.

Prerequisites: Senior standing and CS 430
Typically offered in Fall and Spring

HS 491 Sustainable Agriculture Entrepreneurship Study Abroad (3 credit hours)
This course provides an international perspective on entrepreneurship and sustainability in agricultural and life sciences while examining one of three unique, Spanish-speaking locations (Oaxaca, Mexico; Valencia, Spain; and Queretaro, Mexico. The course is led by three instructors that speak Spanish, have very close ties to the communities visited, and are experts in the fields of sustainability and entrepreneurship. The different components of sustainability: increase in production, efficient use of non-renewable resources, ecological stewardship, economic improvement, and increase in quality of life will be experienced. The practice of entrepreneurship will be identified through examples of the implementation of these sustainable motivators as then analyze different businesses' strengths and constraints. This course intends to give an intimate look into an international location with the intent of getting students out of their comfort zone, challenging their mindsets, and providing the opportunity to experience cultural and agricultural diversity.

Typically offered in Summer only

HS 492 Horticulture Internship (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the Department of Horticultural Science prior to the start of the experience. To gain approval, a student must submit the completed HS 492 contract and have it approved by their experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 493 Research Experience in Horticultural Science (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain research experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the undergraduate coordinator prior to the start of the experience. To gain approval, a student must submit the completed HS 493 contract and have it approved by their research experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete a two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 494 Teaching Experience in Horticultural Science (1-3 credit hours)
A learning experience in Horticultural Science where a student can gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience (135 hours = 3 credits). The experience must be arranged by the student and approved by the undergraduate coordinator prior to the start of the experience. To gain approval, a student must submit the completed HS 494 contract and have it approved by their experience supervisor and the undergraduate coordinator. In addition to the work described in the contract, a student will complete two reflective assignments.

Typically offered in Fall, Spring, and Summer

HS 495 Experimental Courses in Horticultural Science (1-6 credit hours)
Offering of new courses on a trial basis. Topic varies based on offering. Repetition with different course content acceptable up to 2 times and total of 6 units.

Typically offered in Fall, Spring, and Summer

HS 502/PP 502/CS 502 Plant Disease: Methods & Diagnosis (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips arerequired.

Prerequisite: PP 315
Typically offered in Fall only

HS 516/HS 416 Planting Design (4 credit hours)
Developing and cultivating a design process for creating meaningful and compelling ornamental planting designs through the study and practice of spatial articulation (form, enclosure, permeability), physical properties of plants (line, form, texture, color), client/site analysis and program development, visual journaling, garden narrative, presentation skills, utilizing principles of visual composition, design communication, and understanding and resolving technical and horticultural issues in contemporary planting design.

Prerequisite: Landscape Horticulture (11HORTTHL) concentration, HS 400
Typically offered in Fall only

HS 520/HS 420 Green Infrastructure (3 credit hours)
Green infrastructure is defined as the interconnected networks of natural and constructed ecological systems within and in-between urban areas. When implemented in a holistic way, green infrastructure can provide benefits at the residential, neighborhood, community levels providing for greater health and well-being, an improved functional environment, and a thriving dynamic economy. Well-designed urban landscapes offer significant economic and social benefits that directly improve the urban environment for people, plants and animals- from increasing real estate value and reducing energy costs, to enhancing health and food security, and providing habitat for a diverse population of animals and plants. Since addressing environmental issues requires a multidisciplinary approach, this course is designed for any student with interests in horticulture, biological engineering, landscape architecture, environmental sciences, urban forestry, and any others who care about the sustainability of their communities.

Typically offered in Fall only

HS 521/HS 421 Temperate-Zone Tree Fruits: Physiology and Culture (3 credit hours)
Physiology and culture of the major temperate-zone tree fruit and nut crops of the United States. Fundamental principles underlying woody plant growth as applied to the culture of specific tree-fruit crops with emphasis on crops of commercial importance to North Carolina.

Prerequisite: BIO 181 or B0 200
Typically offered in Spring only

HS 523/HS 423 Viticulture (3 credit hours)
A presentation of the commercial importance, distribution, anatomy, physiology, and production of Genus Vitis (grapes) including cultivars, propagation, canopy management, diseases, weed control, physiology, anatomy, irrigation, wine production, climates and soils. This course will not require students to provide their own transportation. Non-scheduled class time for field trips or out-of-class activities IS required for this class

Prerequisite: Junior standing or Senior standing
Typically offered in Spring only

HS 532/HS 432 Introduction to Permaculture (3 credit hours)
Permaculture means "permanent culture," and ..."is the conscious design and maintenance of cultivated ecosystems that have the diversity, stability, and resilience of a natural ecosystem." [Bill Mollison] This course will explore a design/thinking methodology that seeks to provide our essential physical needs, food, water, shelter, energy, etc., while doing so in an environmentally friendly, sustainable manner. This course is restricted to upper level undergraduate, graduate, or matriculated continuing education students. STUDENTS MAY NOT RECEIVE CREDIT FOR BOTH HS 432 AND HS 532.

Typically offered in Fall and Summer

HS 533/HS 433 Public Garden Administration (3 credit hours)
This course addresses the practices, programs, and professional skills that are critical to the successful management of public gardens. The aim of the course is to better prepare graduate students and upper-level undergraduates for potential careers in public garden administration. Topics will include a brief history, impact, and current trends of public gardens in the United States; plant collections; managing staff, volunteers, and boards, and the visiting public; finances and fund raising; educational programming; visitor services; and careers in public gardens. Two Saturday off-campus field trips are required.

Typically offered in Fall only

HS 541/CS 541 Plant Breeding Methods (3 credit hours)
Overview of plant breeding methods for advanced undergraduate and beginning graduate students. Covers principles and concepts of inheritance, germplasm resources, pollen control, measurement of genetic variances, and heterosis. Special topics include heritability, genotype-environment interaction, disease resistance, and polyploidy. In-depth coverage on methods for breeding cross-pollinated and self-pollinated crops. Prepares students for advanced plant breeding courses.

Prerequisite: ST 511, Corequisite: ST 512
Typically offered in Fall only

HS 550 Environmental Nursery Production (3 credit hours)
The course focuses on the impacts of the nursery industry on the environment and environmentally sound nursery practices. Exploration of the major challenges facing the nursery industry that drive decision making during production. Evaluation of past and current research addressing these challenges and sampling procedures and interpretation will be learned. Graduate status and an undergraduate nursery production or management course or working knowledge of nursery production required.

Prerequisite: HS 411, Nursery Management, or an equivalent course.
Typically offered in Fall only

HS 551/HS 451 Plant Nutrition (3 credit hours)
An understanding of the basic mineral nutrient requirements, nutritional monitoring procedures, and fertilizer application methods in horticultural production systems including those for fruits, field vegetables, fruits and vegetables under plasticulture, nursery crops, landscapes, greenhouse flowers and vegetables, interior plantscapes, hydroponics, and organic farming.

Prerequisite: SSC 200
Typically offered in Spring only

HS 562/FS 562/FS 462/HS 462 Postharvest Physiology (3 credit hours)
Preharvest and postharvest factors that affect market quality of horticultural commodities with an emphasis on technologies to preserve postharvest quality and extend storage life of fruits, vegetables and ornamentals.

Typically offered in Spring only

HS 576/HS 476 Crop Physiology and Production in Controlled Environments (3 credit hours)
This course focuses on plant eco-physiological responses to different environmental factors such as: light intensity, quality, duration and penetration; CO2 diffusion; thermodynamic properties of moist air; root environment; air dynamics; water relations; and canopy energy balance. In addition, the course emphasizes the application of controlled environment technologies to manipulate crop responses. The laboratory is designed to optimize the production of edible crops in greenhouses and vertical farms by applying the foundational knowledge of plant eco-physiology in combination with advance controlled environment technologies.

Prerequisite: PB 321 or PB 421 and either MA 114 or MA 121 or MA 131 or MA 141
Typically offered in Spring only

HS 590 Special Problems in Horticultural Science (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in horticultural science.

Typically offered in Fall, Spring, and Summer

HS 601 Professional Presentation Skills in Horticultural Science (2 credit hours)
The purpose of this course is to familiarize the students with the professional presentation skills they need to be successful. These skills include speaking, writing, poster and website development, based on the student's proposed research/project and literature review.

Typically offered in Fall only

HS 610 Special Topics in Horticultural Science (1-6 credit hours)
Investigation of special theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during developmental phase.

Typically offered in Fall, Spring, and Summer

HS 615 Advanced Special Topics (1-6 credit hours)
Investigation of theoretical problems at the 600 level in horticultural science not related to a thesis problem; new 600-level courses during the development phase.

Typically offered in Fall, Spring, and Summer

HS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall, Spring, and Summer

HS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall and Spring

HS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall and Spring

HS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall, Spring, and Summer

HS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall, Spring, and Summer

HS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall, Spring, and Summer

HS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's in Horticultural Science
Typically offered in Summer only

HS 699 Master's Thesis Preparation (1-9 credit hours)
Original research on specific problems in fruit, vegetable and ornamental crops.

Prerequisite: Master's in Horticultural Science
Typically offered in Fall, Spring, and Summer

HS 703 Breeding Asexually Propagated Crops (1 credit hours)
Principles and problems associated with breeding clonally propagated crops and techniques used in overcoming these problems. Taught third five weeks of semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 413
Typically offered in Fall only

HS 704 Plant Nomenclature (1 credit hours)
A practical foundation in plant nomenclature and nomenclatural references. Emphasis on the evolution of international rules for naming plant taxa and their application in both wild and cultivated plants. Nomenclature applications used in patents, cultivar releases and journal articles. Taught mid-semester. Taught five weeks of semester.

Prerequisite: PB 421
Typically offered in Spring only

HS 705 Physiology Of Flowering (1 credit hours)
Examination of physiological basis of flowering in plants such as: floral initiation, transition to reproductive growth; floral development; plant response to light, temperature, nutrition, water supply; plant age; chemical growth regulation and in vitro flowering. Taught first five weeks of fall semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: PB 421
Typically offered in Fall only

HS 707 Environmental Stress Physiology (1 credit hours)
Physiology of plant responses to environmental stresses, with emphasis on current research in selected physiological, molecular, and biochemical mechanisms for tolerance to environmental stresses such as temperature extremes, drought, salt, pathogens and other plants.

Prerequisite: PB 421
Typically offered in Fall only

HS 716/CS 716 Weed Biology (3 credit hours)
This course analyzes the interactions between human disturbance and dynamics of weed populations and communities. Emphasis is given to factors that drive weed control actions and the ecological and evolutionary processes by which weeds survive and adapt to these actions. Similarities and differences between weeds and invasive plant species are discussed as well as benefits and limitations of using traditional ecological theory from natural systems to explain weed behavior in highly disturbed environments.

Prerequisite: CS 414
Typically offered in Spring only

HS 717/CS 717 Weed Management Systems (1 credit hours)
Weed management systems including integration of cultural, biological, mechanical and chemical methods for vegetables, fruits, ornamentals, turf, small grains, corn, tobacco, cotton, peanuts, aquatic and non-cropland settings. Taught second 5 weeksof semester. Drop date is by last day of 3rd week of minicourse.

Prerequisite: CS 414
Typically offered in Fall only

HS 720/CS 720/GN 720 Molecular Biology In Plant Breeding (3 credit hours)
Theory and principles of molecular biology applied to plant breeding. Understanding of the relationship between genes and crop traits. Principles and molecular mechanisms of crop traits, and their applications to solve breeding problems and improve crop traits, which include heterosis, male/female sterility, self-incompatibility, polyploidy, double haploid, protoplast fusion, random mutagenesis, plant regeneration, transgenic breeding, advanced genome editing for breeding, gene silencing, gene activation, gene drive, plant synthetic biology, metabolic engineering, epigenetics for trait improvement, gene stacking, decoy and R genes, and bioconfinement.

P: CS 211 or GN 311 or equivalent, and PB 421 or equivalent.
Typically offered in Spring only

HS 725/SSC 725/TOX 725/CS 725 Pesticide Chemistry (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taughtduring the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Fall only

HS 727/SSC 727/TOX 727/CS 727 Pesticide Behavior and Fate In the Environment (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725,SSC 200
Typically offered in Fall only

HS 729/CS 729 Herbicide Behavior In Plants (2 credit hours)
Chemical, physiological and biochemical actions of herbicides in plants including uptake, translocation, metabolism and mechanism of action.

Prerequisite: BO 751 and BO 752 and CS(HS,SSC) 725
Typically offered in Spring only

HS 745/CS 745/GN 745 Quantitative Genetics In Plant Breeding (1 credit hours)
Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory.

Prerequisite: CS(GN, HS) 541, ST 712, course in quantitative genetics recommended
Typically offered in Spring only

HS 746/CS 746/GN 746 Cytogenetics in Plant Breeding (2 credit hours)
Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies.

Typically offered in Spring only

HS 757/GN 757/ST 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.

Prerequisite: ST 511
Typically offered in Fall only

HS 790 Special Problems in Horticultural Science (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in horticultural science.

Typically offered in Fall, Spring, and Summer

HS 815 Advanced Special Topics (1-6 credit hours)
Investigation of theoretical problems at 600 level in horticultural science not related to a thesis problem; new 600-level courses during development phase.

Typically offered in Fall, Spring, and Summer

HS 860/CS 860/GN 860 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Spring only

HS 861/CS 861/GN 861 Plant Breeding Laboratory (1 credit hours)
Visitation of plant breeding projects in the Depts. of CS and HS at NC State, along with commercial seed companies. Discussion and viewing of breeding objectives, methods and equipment and teaching and practice of hybridization methods.

P: CS 741 or GN 741 or HS 741
Typically offered in Fall only

HS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Typically offered in Fall, Spring, and Summer

HS 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

HS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

HS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

HS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Humanites and Social Sciences (HSS)

HSS 120 Introduction to Humanities & Social Sciences (2 credit hours)
Introduction to humanities and social science disciplines by comparing methods of inquiry and perspectives on a social/cultural issue. The course will also facilitate exploration of college and university resources, opportunities, and policies, and address skills for academic, personal, and career success. First-year entering Humanities and Social Sciences majors only.

R: New Freshmen with majors in the College of Humanities and Social Sciences only
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

HSS 392/COM 392 International and Crosscultural Communication (3 credit hours)
Patterns and problems of verbal and non-verbal forms of crosscultural communication. Avoidance and management of cultural conflict arising from awareness of characteristics and crosscultural communication. Impact on communication of differing cultural perspectives.

GEP Global Knowledge, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

Humanities (HUM)

HUM 295 Humanities Special Topics (3 credit hours)
Special topics course offering for the general education Humanities category.

GEP Humanities
Typically offered in Fall, Spring, and Summer

Humanities and Global Knowledge (HUMG)

HUMG 295 Humanities and Global Knowledge Special Topics (3 credit hours)
Special topics course offering for the general education Humanities and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Humanities (HUM) requirement.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

Humanities and U.S. Diversity (HUMU)

HUMU 295 Humanities and U.S. Diversity Special Topics (3 credit hours)
Special topics course offering for the general education Humanities and U.S. Diversity categories. This course may be used for the U.S Diversity (USD) co-requisite and/or for the Humanities (HUM) requirement.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

Immunology (IMM)

IMM 751/MB 751 Immunology (3 credit hours)
Introduction to mechanisms of immunity in man and animals. Emphasis on interactions between cells of the immune system in production of immune responses and the molecules in control of these interactions.

Prerequisite: BCH 451, GN 411, MB 351
Typically offered in Spring only

IMM 757/PO 757 Comparative Immunology (3 credit hours)
Compare and contrast the immune system structure and function of animal species of agricultural and veterinary significance with that of humans and traditional biomedical model organisms. Discuss key evolutionary differences, how different species use different mechanisms to achieve the same outcomes, and the clinical implications for these differences.

Prerequisite: MB 751 or MB 441 or BIO 414
Typically offered in Spring only

IMM 783/MB 783/CBS 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only

Industrial and Systems Engineering (ISE)

ISE 135 Computer-Based Modeling for Engineers (3 credit hours)
Introductory course in computer-based modeling and programming using Python for Engineering Applications. Emphasis on algorithm development and engineering problem solving. Methodical development of Python scripts to link with Microsoft Excel using xlwings plugin through proper specifications; documentation, style; control structures; data types and data abstraction; graphical user interface design. Projects: design problems from industrial engineering systems. Functional relationships will be given and programs will be designed and developed from a list of specifications.

Prerequisite: E 115, Corequisite: MA 141
Typically offered in Fall and Spring

ISE 215 Foundations of Design & 3D Modeling for Engineers (1 credit hours)
This is an 8 week course. An introductory engineering graphics course which builds on the foundations of computer-aided 2D sketching and 3D modeling for industrial engineers. Students will develop and refine their ability to communicate designs via modeling techniques prolific in industry. The concurrent nature of ideation, engineering analysis and manufacturing will be emphasized as students review case studies and develop their own models. Constraint-based design will drive strategies that accurately reflect design intent and promote part family relationships and automation. Students will work in small teams to create a mechanism that must achieve certain functional criteria. ISE majors have priority registration for this course.

Prerequisite: E115 and Corequisite: ISE216
Typically offered in Fall and Spring

ISE 216 Product Development and Rapid Prototyping (3 credit hours)
Introduction to product development and prototyping. Team-based development of a new product during the semester. Specific topics are voice of the customer, product specification and parameter specification, Quality Function Deployment and the House of Quality, concept generation, concept selection, detailed design using SolidWorks, prototyping, design for assembly, design for the environment, and intellectual properties and patents. Team presentations of a functional prototype of their product at the end of the semester.

Corequisite: ISE 215
Typically offered in Fall and Spring

ISE 311 Engineering Economic Analysis (3 credit hours)
Engineering and managerial decision making. The theory of interest and its uses. Equivalent annual costs, present worth, internal rates of return, and benefit/cost ratios. Accounting depreciation and its tax effects. Economic lot size and similar cost minimization models. Sensitivity analysis. Cost dichotomies: fixed vs. variable, and incremental vs. sunk, use of accounting data. Replacement theory and economic life. Engineering examples.

Prerequisite: Grade of C or better in MA 141
Typically offered in Fall, Spring, and Summer

ISE 315 Introduction to Computer-Aided Manufacturing (1 credit hours)
This is an 8 week course. Introduction to the principles of modern-day multi-axis machine tool control, using computer-aided manufacturing (CAM) software tools. Emphasis is placed on transferring part geometry from CAD to CAM, for the development of CNC-ready programs. Industry file formats, machining strategies, G & M-code generation, optimization and verification techniques will also be investigated. Upon successful completion of this course, students will be able to demonstrate proficiency in the use of industry-relevant CAD/CAM software and will be able to extend that knowledge to practice through exercises and projects. Use of CNC machine tools will be introduced and demonstrated in the department's physical lab spaces. ISE majors have priority registration for this course.

Prerequisite: ISE 215 and Co-requisite: ISE 316
Typically offered in Fall, Spring, and Summer

ISE 316 Manufacturing Engineering I - Processes (3 credit hours)
Analytical study and design of manufacturing engineering with emphasis on mfg. and processes. Addresses the interaction of design, materials, and processing. Laboratory instruction and hands-on experience in metrology, machining, process planning,economic justification, and current mfg. methodologies.

Prerequisite: MSE 200 and ISE 216; Co-requisite: ISE 315
Typically offered in Fall, Spring, and Summer

ISE 352 Fundamentals of Human-Machine Systems Design (3 credit hours)
Introduction to work methods and ergonomics. Coverage of methods to improve operator performance and production process efficiency. Techniques include project evaluation and review, operator-machine ratios, line balancing, work sampling, time study, wage payment, and pre-determined time systems. Ergonomics component includes workstation and hand-tool design, and methods for designing cognitive work and work environment.

Prerequisite: C- or better in ST 371; C or better in ISE 135
Typically offered in Fall and Spring

ISE 361 Deterministic Models in Industrial Engineering (3 credit hours)
Introduction to mathematical modeling, analysis techniques, and solution procedures applicable to decision-making problems in a deterministic environment. Linear programming models and algorithms and associated computer codes are emphasized.

Prerequisite: (MA 303 or MA 341) and C or better in ISE 135
Typically offered in Fall, Spring, and Summer

ISE 362 Stochastic Models in Industrial Engineering (3 credit hours)
Introduction to mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production systems. Methodologies covered include probability theory and stochastic processes. Applications relate to design and analysisof problems, capacity planning, inventory control, waiting lines, and system reliability and maintainability.

Prerequisite: C or better in ISE 135 and (MA 303 or MA 341) and C- or better in ST 371 or ST 370
Typically offered in Fall and Spring

ISE 398 Lean Six Sigma for Industrial Engineering (1 credit hours)
This course leverages the Lean Six Sigma framework to analyze and solve problems as related to quality improvement projects. Students in this course will apply the Lean Six Sigma philosophy and goals to build problem-solving, analytical and technical skills while implementing successful change management techniques.

Corequisite: ISE 498 or ISE 521
Typically offered in Fall and Spring

ISE 408 Design and Control of Production and Service Systems (3 credit hours)
This course focuses on understanding the behavior of manufacturing plants and service systems through a thorough, generalizable and fundamental understanding of the factors affecting their behavior.

Prerequisite: ISE 135, ISE 362, and C- or better in ST 371
Typically offered in Fall and Spring

ISE 411/ISE 511 Supply Chain Economics and Decision Making (3 credit hours)
This course introduces students to the principles of microeconomic analysis applied to decision-making in supply chains. Emphasis will be put on strategic interactions between different decision makers in the supply chain, including suppliers, manufacturers, retailers, and consumers. Topics include classical demand and production theory, pricing and revenue management, competition between firms, and cooperation between and within firms under information asymmetry.

Prerequisite: ISE 135
Typically offered in Fall only

ISE 413/ISE 513 Humanitarian Logistics (3 credit hours)
This course provides a comprehensive treatment of humanitarian logistics (HumLog) from an operations research perspective, focusing on the use of quantitative modeling for decision making and best practices disaster management. Background and overview on disaster management will be covered. The four phases of the disaster management cycle are introduced as well as the types of decisions that are made in each phase. Mathematical models are presented for typical humanitarian logistics decisions, such as inventory prepositioning, facility location, transportation, routing and capacity planning.

Prerequisite: ISE 361
Typically offered in Spring only

ISE 416 Manufacturing Engineering II - Automation (3 credit hours)
Integration of design and mfg. through computer aided/automated process planning, concurrent engineering, and rapid prototyping. Fixed and programmable automation in mfg. and service. Autonomous mfg. systems such as computer numerical control (CNC), industrial robotics, automated inspection, electronics manufacturing and assembly.

Prerequisite: ISE 316
Typically offered in Fall only

ISE 417 Database Applications in Industrial & Systems Engineering (3 credit hours)
Rapid applications development (RAD) tools to design and implement database-based applications. The SQL database query language, a standard RAD environment and how to access information in a database from it, use of Visual Basic for Applications, and how to integrate these tools together to design and build engineering applications. Examples will be from manufacturing and production systems.

Prerequisite: C or better in ISE 135
Typically offered in Fall, Spring, and Summer

ISE 425/OR 425/OR 525/ISE 525 Medical Decision Making (3 credit hours)
This will focus on the use of optimization in Medicine. The main goal of this course is for you to develop an understanding of the recent methodological literature on optimization methods applied to medical decision making. We will cover a broad range of topics, both from the methodological perspective (study models using integer programming, dynamic programming, simulation, etc.) and from the public policy/public health perspective (who are the stake holders, what are the relevant questions modelers can answer, how is the patient taken into account, etc.).

P: ISE/OR 505 or equivalent and ISE 560 or equivalent or permission by instructor
Typically offered in Spring only

ISE 433/ISE 533/OR 433/OR 533 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.

Prerequisite: ISE 361
Typically offered in Spring only

ISE 435/ISE 535 Python Programming for Industrial & Systems Engineers (3 credit hours)
The objective of this course is to build on your knowledge of computing and data analysis by focusing on programming using the Python language. IN particular, you will learn more about the Python and its ecosystem of libraries, how to use data structures in Python programs, conduct File I/O operations, and perform numerical and scientific computing within Python. This course is designed for senior undergraduate and graduate students to get the basics of the Python language and learn to use it to perform scientific computing within Python with two of its most popular packages in use for heavy data intensive analysis - Numpy and SciPy. Several engineering examples from physics, industrial engineering core courses and general engineering will be used to contextualize the programming examples.

Prerequisites: ST 370 OR ST 371 and ISE 135 OR CSC 111 OR CSC 113 OR CSC 116 or ST 307 OR ST 308 OR ECE 209. Restrictive Statement: Department Approval Required
Typically offered in Fall only

ISE 437 Data Analytics for Industrial Engineering (3 credit hours)
In this course undergraduate students will learn to integrate statistical and mathematical modeling tools they learned in their previous classes to be able to design, develop and implement comprehensive advanced analytics solutions to address real industry problems. All class modules will be illustrated through real applications in Media, Financial, Retail and Manufacturing industries.

Prerequisites: (ST 370 or ST 371) and (ISE 135 or CSC 111 or CSC 113 or CSC 116 or ST 307 or ST 308 or ECE 209) and ISE 361.
Typically offered in Spring only

ISE 441 Introduction to Simulation (3 credit hours)
Discrete-event stochastic simulation for the modeling and analysis of systems. Programming of simulation models in a simulation language. Input data analysis, variance reduction techniques, validation and verification, and analysis of simulation output. Random number generators and random variate generation.

Prerequisite: MA 242, ST 372, ISE 362 and C or better in ISE 135
Typically offered in Fall and Spring

ISE 443 Quality Design and Control (3 credit hours)
Statistical methods in quality control. Control charts for variables and attributes. Process capability assessment. Role of experimentation in designing for quality. Total Quality Management. Tools for continuous quality improvement. Quality Function Deployment.

Prerequisite: ST 372 Restriction: ST 435 cannot be used as a substitute for this course.
Typically offered in Fall and Spring

ISE 447/ISE 547 Applications of Data Science in Healthcare (3 credit hours)
Health professional are capable of collecting massive amounts of data and look for best strategies to use this information. Healthcare analytics have the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases and improve the quality of life in general. This course will explore some of the frequently used data science methods in healthcare and examine a compilation of the most recent academic journal articles on the subject. Students are expected to have a strong background in optimization and stochastic modeling.

Prerequisite: ISE 362
Typically offered in Fall only

ISE 452 Advanced Human-Machine Systems Design (3 credit hours)
Advanced concepts in human-machine systems design. Consideration of anatomical and physiological bases for design of work systems. Advanced biomechanical analysis and modeling for manual material handling design. Physiological and psychological capabilities and limitations as related to work systems design and human performance. Coverage of human information processing and performance theories and models, including pipe-line, signal detection theory, information theory, and motor control theory. Additional topics include human factors experimentation and neuroergonomics (brain and behavior).

Prerequisite: CE 214 and ISE 352
Typically offered in Spring only

ISE 453 Modeling and Analysis of Supply Chains (3 credit hours)
This course presents an overview of the basic issues and strategies involved in operating today's global supply chains, from the design of the supply chain network through the management and location of inventories to the design and operation of the logistics systems that distribute goods from their source to the consumer.

Prerequisite: ST 371 (C- or better), ISE 135, ISE 361, ISE 362
Typically offered in Fall and Spring

ISE 462 Advanced Stochastic Models in Industrial Engineering (3 credit hours)
Advanced topics related to mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production systems. Methodologies covered include economic analysis under uncertainty, discrete and continuous time stochastic processes. Applications relate to design, analysis and control relating to capacity planning, inventory control, waiting lines, and system reliability and maintainability.

Prerequisite: ISE 362
Typically offered in Fall only

ISE 489 Special Topics in Industrial and Systems Engineering (1-3 credit hours)
Directed coursework in Industrial and Systems Engineering with an emphasis on special topics and emerging areas of interest within the discipline.

Typically offered in Fall, Spring, and Summer

ISE 495 Project Work in Industrial Engineering (1-3 credit hours)
Special investigations, study or research related to the field of industrial engineering. In a given semester several students and/or student groups may be working in widely divergent areas under the direction of several members of the faculty.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

ISE 498 Senior Design Project (3 credit hours)
Individual or group design projects requiring problem definition and analysis, synthesis, specification and presentation of a designed solution. Students work under faculty supervision either on actual industrial engineering problems posed by local industrial, service and governmental organization or on emerging research issues.

Prerequisite: ISE 408 and ISE 441 and ISE 453
Typically offered in Fall and Spring

ISE 501/OR 501 Introduction to Operations Research (3 credit hours)
Operations Research (OR) is a discipline that involves the development and application of advanced analytical methods to aid complex decisions. This course will provide students with the skills to be able to apply a variety of analytical methods to a diverse set of applications. Methods considered include linear and mixed-integer programming, nonlinear and combinatorial optimization, network models, and machine learning. Focus will be on how to translate real-world problems into appropriate models and then how to apply computational procedures and data so that the models can be used as aids in making decisions. Applications will include improving the operation of a variety of different production and service systems, including healthcare delivery and transportation systems, and also how OR can be used to make better decisions in areas like sports, marketing, and project management. Prerequisites include undergraduate courses in single variable differential and integral calculus and an introductory course in probability.

Prerequisites include undergraduate courses in single variable differential and integral calculus (similar to MA 421) and an introductory course in probability (similar to ST 421 or ST 371 and ST 372)
Typically offered in Fall and Spring

ISE 505/MA 505/OR 505 Linear Programming (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.

Prerequisite: MA 405
Typically offered in Fall only

ISE 510 Applied Engineering Economy (3 credit hours)
Engineering economy analysis of alternative projects including tax and inflation aspects, sensitivity analysis, risk assessment, decision criteria. Emphasis on applications.

Prerequisite: Undergrad. courses in engineering economics and ST
Typically offered in Spring only

ISE 511/ISE 411 Supply Chain Economics and Decision Making (3 credit hours)
This course introduces students to the principles of microeconomic analysis applied to decision-making in supply chains. Emphasis will be put on strategic interactions between different decision makers in the supply chain, including suppliers, manufacturers, retailers, and consumers. Topics include classical demand and production theory, pricing and revenue management, competition between firms, and cooperation between and within firms under information asymmetry.

Prerequisite: ISE 135
Typically offered in Fall only

ISE 513/ISE 413 Humanitarian Logistics (3 credit hours)
This course provides a comprehensive treatment of humanitarian logistics (HumLog) from an operations research perspective, focusing on the use of quantitative modeling for decision making and best practices disaster management. Background and overview on disaster management will be covered. The four phases of the disaster management cycle are introduced as well as the types of decisions that are made in each phase. Mathematical models are presented for typical humanitarian logistics decisions, such as inventory prepositioning, facility location, transportation, routing and capacity planning.

Prerequisite: ISE 361
Typically offered in Spring only

ISE 515 Manufacturing Process Engineering (3 credit hours)
Manufacturing process engineering, primary, secondary, finishing and assembly processes. Traditional and non-traditional manufacturing processes, group technology, manufacturing analyses and application of economic analyses. Graduate standing in Engineering.

Typically offered in Fall and Summer

ISE 519 Database Applications in Industrial and Systems Engineering (3 credit hours)
Rapid application development (RAD) tools to design and implement database-based applications. This includes: SQL query language, Visual Basic for Applications in database application construction, a standard RAD environment and how to access information in a database, entity/attribute modeling of the database structure, anomalies of database structures that create problems for applications, modeling of application system's functionality, and integrating these tools together to design and implement engineering applications. Examples from manufacturing and production systems. Restricted to advanced undergraduates and graduate students.

Prerequisite: ISE 110
Typically offered in Fall and Spring

ISE 520 Healthcare Systems Performance Improvement I (3 credit hours)
Methods used to improve the performance of health care delivery systems with emphasis on patient care cost, access, and quality. Adaptation of lean and six-sigma to rapid and continuous health care systems improvement through organizational and process transformation. Fundamentals of scheduling, staffing, and productivity in health systems employing simulation and optimization. Health care policy and management.

Prerequisite: ST 372, ISE 352, ISE 361, and ISE 441
Typically offered in Fall only

ISE 521 Healthcare Systems Performance Improvement II (3 credit hours)
Continuation of ISE 520 with a concentration on the completion of a healthcare systems process improvement project at the sponsoring health care institution. Project must employ the tools and techniques of healthcare systems process improvement. The project is done in conjunction with a diverse and multi-disciplinary team from the healthcare institution. The student must serve as a facilitator and coach, resulting in a project with measured success. Success will be determined by the improvement in patient care as quantified in cost, quality, and access.

Prerequisite: ISE 520
Typically offered in Spring only

ISE 525/ISE 425/OR 425/OR 525 Medical Decision Making (3 credit hours)
This will focus on the use of optimization in Medicine. The main goal of this course is for you to develop an understanding of the recent methodological literature on optimization methods applied to medical decision making. We will cover a broad range of topics, both from the methodological perspective (study models using integer programming, dynamic programming, simulation, etc.) and from the public policy/public health perspective (who are the stake holders, what are the relevant questions modelers can answer, how is the patient taken into account, etc.).

P: ISE/OR 505 or equivalent and ISE 560 or equivalent or permission by instructor
Typically offered in Spring only

ISE 533/OR 433/OR 533/ISE 433 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.

Prerequisite: ISE 361
Typically offered in Spring only

ISE 535/ISE 435 Python Programming for Industrial & Systems Engineers (3 credit hours)
The objective of this course is to build on your knowledge of computing and data analysis by focusing on programming using the Python language. IN particular, you will learn more about the Python and its ecosystem of libraries, how to use data structures in Python programs, conduct File I/O operations, and perform numerical and scientific computing within Python. This course is designed for senior undergraduate and graduate students to get the basics of the Python language and learn to use it to perform scientific computing within Python with two of its most popular packages in use for heavy data intensive analysis - Numpy and SciPy. Several engineering examples from physics, industrial engineering core courses and general engineering will be used to contextualize the programming examples.

Prerequisites: ST 370 OR ST 371 and ISE 135 OR CSC 111 OR CSC 113 OR CSC 116 or ST 307 OR ST 308 OR ECE 209. Restrictive Statement: Department Approval Required
Typically offered in Fall only

ISE 537 Statistical Models for Systems Analytics in Industrial Engineering (3 credit hours)
In this course, graduate students will learn basic data science methodologies. Examples of the methodologies include linear regression, generalized linear models, regularization and variable selection, and dimensionality reduction. In addition, students will also learn how to use these methods to solve real-world Industrial Engineering-related problems by analyzing industrial datasets and projects.

Prerequisite: ST 370: "Probability and Statistics for Engineers" or equivalent
Typically offered in Fall only

ISE 540/PSY 540 Human Factors In Systems Design (3 credit hours)
Introduction to problems of the systems development cycle, including human-machine function allocation, military specifications, display-control compatibility, the personnel sub-system concept and maintainability design. Detailed treatment given to people as information processing mechanisms.

Prerequisite: IE 452 or PSY 340, Corequisite: ST 507 or 515
Typically offered in Spring only

ISE 541 Occupational Safety Engrg (3 credit hours)
Occupational accident-injury study; morbidity, mortality; investigation and analysis. Hazard control; energy countermeasure strategies; control technology. Impact biomechanics, trauma and survivability. Risk assessment; systems safety analysis. Product design, manufacturing defects, system failures and human error as causative factors. Safety program development. Near-accident reporting. OSHA compliance; standards. Accident, trauma and forensic case studies from manufacturing, motor carrier andconstruction industries.

Typically offered in Spring only

ISE 543 Musculoskeletal Mechanics (3 credit hours)
Anatomy, physiology and biomechanics of musculoskeletal system including muscle bone, tendon, ligament, cartilage, nerve. Modeling of tissue and joints with special emphasis on spine and upper extremity. Physical, mathematical, optimization and finite element modeling techniques as applied in biomechanics research.

Prerequisite: BIO 125 or BAE(BIO) 235 or Graduate standing

ISE 544 Occupational Biomechanics (3 credit hours)
Anatomical, physiological, and biomechanical bases of physical ergonomics. Strength of biomaterials, human motor capabilities, body mechanics, kinematics and anthropometry. Use of bioinstrumentation, active and passive industrial surveillance techniques and the NIOSH lifting guide. Acute injury and cumulative trauma disorders. Static and dynamic biomechanical modeling. Emphasis on low back, shoulder and hand/wrist biomechanics.

Prerequisite: Graduate standing
Typically offered in Fall only

ISE 546/CSC 546 Management Decision and Control Systems (3 credit hours)
Planning, design, and development and implementation of comprehensive computer-based information systems to support management decisions. Formal information systems principles; information requirements analysis; knowledge acquisition techniques; information modeling. Information resource management for quality operational control and decision support; system evaluation, process improvement and cost effectiveness.

Prerequisite: CSC 423 or BUS 541
Typically offered in Fall only

ISE 547/ISE 447 Applications of Data Science in Healthcare (3 credit hours)
Health professional are capable of collecting massive amounts of data and look for best strategies to use this information. Healthcare analytics have the potential to reduce costs of treatment, predict outbreaks of epidemics, avoid preventable diseases and improve the quality of life in general. This course will explore some of the frequently used data science methods in healthcare and examine a compilation of the most recent academic journal articles on the subject. Students are expected to have a strong background in optimization and stochastic modeling.

Prerequisite: ISE 362
Typically offered in Fall only

ISE 552 Design and Control of Production and Service Systems (3 credit hours)
Basic terminology and techniques for the control of production and service systems including economic order quantity models; stochastic inventory models; material requirements planning; Theory of Constraints; single and mixed model assembly lines ; and lean manufacturing. Emphasis on mathematical models of the interaction between limited capacity and stochastic variability through the use of queueing models to describe system behavior.

Prerequisite: ST 371 or ST 372
Typically offered in Fall only

ISE 553 Modeling and Analysis of Supply Chains (3 credit hours)
Basic issues in operating supply chains, using state of the art modeling tools available for their analysis. Emphasis on using engineering models to develop insights into the behavior of these systems.

Prerequisite: ISE 361 and ST 372
Typically offered in Spring only

ISE 555 Digital Manufacturing (3 credit hours)
This course aims to introduce students on the power of digital manufacturing and design technologies, particularly how product data can seamlessly transfer through the entire lifecycle of a manufactured product. Students will also be introduced to methods to design and build plugin apps that interface with the design models. All hands-on modeling and virtual manufacturing exercises will be in Autodesk Fusion 360, a cloud based design and manufacturing software.

R: ISE 316 or Graduate Standing
Typically offered in Fall only

ISE 560/OR 560 Stochastic Models in Industrial Engineering (3 credit hours)
ISE/OR 560 will introduce mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production and service systems. Methodologies covered include probability theory and stochastic processes including discrete and continuous Markov processes. Applications relate to design and analysis of problems, capacity planning, inventory control, waiting lines, and service systems.

Typically offered in Fall only

ISE 562/TE 562/OR 562 Simulation Modeling (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.

Typically offered in Spring only

ISE 589 Special Topics In Industrial Engineering (1-6 credit hours)
Special developments in some phase of industrial engineering using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

ISE 601 Seminar (1 credit hours)
Seminar discussion of industrial engineering problems for graduate students. Case analyses and reports.

Typically offered in Fall and Spring

ISE 610 Special Topics in Industrial Engineering (3-6 credit hours)
Special developments in some phase of industrial engineering using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

ISE 637 Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Typically offered in Fall and Summer

ISE 639 Advanced Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing an opportunity for individual graduate students to explore advanced topics of special interest under the direction of a member of the faculty.

Typically offered in Fall, Spring, and Summer

ISE 677 Industrial Engineering Projects (1-6 credit hours)
Investigation and written report on assigned problems germane to industrial engineering. Maximum of six credits to be earned for MIE degree.

Prerequisite: MIE candidates
Typically offered in Fall, Spring, and Summer

ISE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Typically offered in Fall, Spring, and Summer

ISE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

ISE 699 Master's Thesis Preparation (1-9 credit hours)
For student who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ISE 707 Real-Time Control of Automated Manufacturing (3 credit hours)
Concepts and application of real-time control of automated manufacturing systems. Development of prototype manufacturing control applications involving introductions to following topics: computer architecture; real-time, multi-tasking operating systems; data modeling; multi-processing systems; local area networks; inter-task communication; and development of multi-tasking control systems. Design development of control system.

Typically offered in Fall only

ISE 708/MA 708/OR 708 Integer Programming (3 credit hours)
General integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. Students have some "hands on" computing experience that should enable them to adapt ideas presented in course to integer programming problems they may encounter.

Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112)
Typically offered in Spring only

ISE 709/OR 709 Dynamic Programming (3 credit hours)
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.

Prerequisite: MA 405, ST 421
Typically offered in Spring only

ISE 711 Capital Investment Economic Analysis (3 credit hours)
Analysis of economic merits of alternatives including interest and income tax considerations. Risk and sensitivity exploration techniques. Introduction to analytical techniques for multiple objectives or criteria. Use of mathematical programming andcomputers for capital budgeting.

Prerequisites: ISE 311 and ST 371
Typically offered in Fall only

ISE 712 Bayesian Decision Analysis For Engineers and Managers (3 credit hours)
The Bayesian approach to decision making, with numerous applications in engineering and business. Expected value maximization, decision trees, Bayes' theorem, value of information, sequential procedures and optimal strategies. Axiomatic utility theory and controversies, utility of money, theoretical and empirical determination of utility functions and relationship to mean-variance analysis. Brief introduction to multi-attribute problems, time streams and group decisions.

Prerequisite: ST 371 or ST 421
Typically offered in Spring only

ISE 714 Product Manufacturing Engineering for the Medical Device Industry (3 credit hours)
Product development course targeted toward the medical device industry. Product design and development, concept generation and selection, parametric feature-based CAD, design for manufacturability (DFM) and assembly (DFA), tolerancing, rapid prototyping, tool design, tool fabrication, and medical device fabrication.

Prerequisite: ISE 515
Typically offered in Spring only

ISE 715 Manufacturing Process Engineering (3 credit hours)
Manufacturing process engineering, primary,secondary, finishing and assembly processes. concurrent engineering, process planning, group technology, manufacturing analyses and application of economic analyses.

Typically offered in Spring only

ISE 716 Automated Systems Engineering (3 credit hours)
General principles of operation and programming of automated systems. Automated assembly, automated manufacturing, and inspection systems. Control of automated manufacturing. Industrial logic systems and programmable logic controllers. Computer numerical control, industrial robotics, and computer integrated manufacturing.

Typically offered in Fall and Spring

ISE 718 Micro/Nano-Scale Fabrication and Manufacturing (3 credit hours)
Introduction to physical theory, process design, analysis, and characterization of micro/nano scale fabrication and manufacturing. The main focus of the course is on the fabrication/manufacturing of important types of microstructures used in micro/nano devices and the techniques and tools used to fabricate and characterize them.

Prerequisite: ISE 316 or graduate standing in the college of engineering
Typically offered in Spring only

ISE 723 Production Planning, Scheduling and Inventory Control (3 credit hours)
An analysis of Production-Inventory systems. Discussion of commonly used planning and scheduling techniques. Introduction to use of math modeling for solution of planning and scheduling problems. Interface with quality control and information systems.

Prerequisite: OR 501 and ST 511
Typically offered in Spring only

ISE 725 Foundations of Smart Manufacturing (3 credit hours)
The course introduces the concepts and applications of smart manufacturing systems that begin from the machine asset on the factory floor to the higher order information technology systems. Development of prototype smart manufacturing applications involving introduction to topics such as: real-time streaming machine sensor data through machine to machine (m2m) industrial communication protocols; unified namespaces for factory integration of information and operational technology; data modeling and data store architectures specifically for time series analysis and machine vision theory and applications critical to quality inspections at the factory floor.

Typically offered in Spring only

ISE 726 Theory of Activity Networks (3 credit hours)
Introduction to graph theory and network theory. In-depth discussion of theory underlying (1) deterministic activity networks (CPM): optimal time-cost trade offs; the problem of scarce resources; (2) probabilistic activity networks (PERT): critical evaluation of underlying assumptions; (3) generalized activity networks (GERT, GAN): applications of signal flow graphs and semi-Markov process to probabilistic branching; relation to the theory of scheduling.

Prerequisite: OR 501, OR(IE,MA) 505
Typically offered in Spring only

ISE 731 Multi-Attribute Decision Analysis (3 credit hours)
Specification of attributes/criteria/objectives for complex decisions. Determination of alternatives, attribute weights and decision-making process. Graphical and weighted evaluation techniques. Multi-attribute utility, multi-objective/goal programming and analytic hierarchy process methodologies. Computer applications and case studies.

Typically offered in Spring only

ISE 740/PSY 740 Engineering Psychology of Human-computer Interaction (3 credit hours)
Exploration of usability of computer technology. Theory and practice of user-centered design for HCI applications. Course focuses on current usability paradigms and principles, psychology of users, iterative and participatory design processes, system requirements specification, prototyping, user support systems, usability evaluation and engineering, interface design guidelines and standards. Application domains include, universal design, virtual reality, and scientific data visualization.

Prerequisite: IE(PSY) 540 or CSC 554

ISE 741 Systems Safety Engineering (3 credit hours)
Systems safety engineering. Course familiarizes students with techniques for identifying and recognizing potential safety hazards and the concept of risk assessment. Preliminary Hazard Analysis, Failure Modes and Effects Analysis, System and Subsystem Hazard Analysis, Fault Tree Analysis, Process Safety Management (29CFR1910.119) are explored together with applications to hazard analysis and control. Industrial situations and case studies are employed to illustrate usefulness of various system safety techniques.

Typically offered in Fall only

ISE 742 Environmental Stress, Physiology and Performance (3 credit hours)
Human skilled performance as affected by environmental stressors, including noise, vibration, heat, cold, accelerator, pressure altitude, toxic agents and illumination. Physiological effects of stressors and their relationship to health, performanceand, ultimately, to safety. Impact biomechanics and crash survival. Human survival in adverse environments. Combined stressor effects, physiological arousal, fatigue and performance decrement.

Typically offered in Spring only

ISE 743/PSY 743 Ergonomic Performance Assessment (3 credit hours)
Fundamentals of ergonomic performance measurement used to assess the effects of environment and system design on human performance. Treatment of topics such as workload measurement, measurement of complex performance, simulator studies, measurement of change, task taxonomies, criterion task sets and statistical methods of task analysis. Problems of laboratory and field research, measurement of change and generalizability of findings.

Prerequisite: PSY 200, ST 507 and 508
Typically offered in Fall only

ISE 744 Human Information Processing (3 credit hours)
Fundamentals of human information processing basic to skilled operator performance and the design of displays, controls and complex systems. Treatment of topics such as channel capacity, working memory, long-term memory, decision making, attention and process monitoring. Problems of display and control design and evaluation, evaluation of textual material, and human-computer interaction.

Prerequisite: PSY 200, ST 507 and 508
Typically offered in Spring only

ISE 745/PSY 745 Human Performance Modeling (3 credit hours)
Advanced aspects of human performance research. Qualitative models of human information processing. Characteristics and role of memory in decision making and response execution. Sensory channel parameters, attention allocation, time-sharing of tasks. Situation awareness and workload responses in complext tasks. Limitations of human factors experimentation. Factors in human multiple task performance. Cognitive task analysis and computational cognitave modeling/simulation of user behavior in specific applications.

Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744

ISE 747/OR 747 Reliability Engineering (3 credit hours)
Introduction to basic concepts of reliability engineering. Application of probability and statistics to estimate reliability of industrial systems; development of reliability measures; analysis of static and dynamic reliability models; development and analysis of fault trees; analysis of Markovian and non-Markovian models; and optimization of reliability models.

Prerequisite: ST 511
Typically offered in Fall only

ISE 748 Quality Engineering (3 credit hours)
Introduction to basic concepts of quality engineering. Statistical process control (SPC) methods, acceptance sampling techniques, concept of parameter design and statistical as well as analytical techniques for its implementation, tolerance analysisand design, components of cost of poor quality and an introduction to quality management.

Prerequisite: OR 501, ST 511
Typically offered in Spring only

ISE 754 Logistics Engineering (3 credit hours)
Elements of logistics networks. Supply chain design: facility location and allocation; great-circle distances; geocoding. Multi-echelon production and inventory systems; sourcing decision systems. Vehicle routing: exact, approximation, and heuristic procedures; traveling salesman problem; basic vehicle routing problem and extensions; backhauling; mixed-mode transportation system design.

Prerequisite: ISE 453
Typically offered in Spring only

ISE 760/OR 760 Applied Stochastic Models in Industrial Engineering (3 credit hours)
Formulation and analysis of stochastic models with particular emphasis on applications in industrial engineering; univariate, multivariate and conditional probability distributions; unconditional and conditional expectations; elements of stochastic processes; moment-generating functions; concepts of stochastic convergence; limit theorems; homogeneous, nonhomogeneous and compound Poisson processes; basic renewal theory; transient and steady-state properties of Markov processes in discrete and continuous time.

Prerequisite: MA 303, ST 371
Typically offered in Fall only

ISE 761/OR 761 Queues and Stochastic Service Systems (3 credit hours)
Introduction of general concepts of stochastic processes. Poisson processes, Markov processes and renewal theory. Usage of these in analysis of queues, from with a completely memoryless queue to one with general parameters. Applications to many engineering problems.

Typically offered in Spring only

ISE 762/CSC 762/OR 762 Computer Simulation Techniques (3 credit hours)
Basic discrete event simulation methodology: random number generators, generating random objects, design of discrete event simulation, validation, analysis of simulation output, variance reduction techniques, Markov chain Monte Carlo, simulation optimization. The course has computer assignments and projects.

Students should have completed a course on stochastic models (similar to ISE 560 or ISE 760) and have a working knowledge of a programming language (e.g., Python, Matlab, R, or others).
Typically offered in Fall and Spring

ISE 766/MA 766/OR 766 Network Flows (3 credit hours)
Study of problems of flows in networks. These problems include the determination of shortest chain, maximal flow and minimal cost flow in networks. Relationship between network flows and linear programming developed as well as problems with nonlinear cost functions, multi-commodity flows and problem of network synthesis.

Prerequisite: OR(IE,MA) 505
Typically offered in Spring only

ISE 767 Upper Extremity Biomechanics (3 credit hours)
Gross and functional anatomy of upper extremity; properties of tendons and synovial fluid; epidemiology; disorders of shoulder, elbow, wrist, hands, fingers; biomechanical modeling; personal factors affecting cumulative trauma disorder (CTD) risk, diagnosis and treatment of upper extremity CTDs; wrist splints; workplace ergonomics to alleviate upper extremity CTDs.

Typically offered in Fall only

ISE 768 Spine Biomechanics (3 credit hours)
Gross and fine anatomy of spine, mechanism of pain, epidemiology, in vitro testing, psychophysical studies, spine stability models, bioinstrumentation: intradiscal pressure, intra-abdominal pressure and electromyography. Biomechanics of lifting and twisting, effects of vibration, effects of posture/lifting style, lifting belts, physical models, optimization models, mathematical models, muscle models, finite element models, current trends in medical management and rehabilitation, chiropractic.

Typically offered in Fall only

ISE 772/OR 772 Stochastic Simulation Design and Analysis (3 credit hours)
This course is methodologically focused and a continuation of ISE 762 in Monte Carlo methods. The topics include, but are not limited to, Quasi-Monte Carlo, importance sampling and other advanced variance reduction approaches, derivative estimation, and advanced simulation optimization in continuous and finite spaces. While the application of these techniques to actual simulations is practiced as assignments, the discussion on simulation software and programming will be minimal. A current topic research presentation/paper required.

Prerequisite: (CSC,ECE,IE,OR) 762 and ST 516
Typically offered in Spring only

ISE 789 Advanced Special Topics In Industrial Engineering (3-6 credit hours)
Advanced topics in some phase of industrial engineering using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

Typically offered in Fall and Spring

ISE 790 Advanced Special Topics System Optimization (1-6 credit hours)
Advanced topics in some phase of system optimization using traditional course format. Identification of various specific topics and prerequisites for each section from term to term.

Typically offered in Fall and Spring

ISE 794 Advanced Problems in Ergonomics (3 credit hours)
Exploration in depth of a problem area of contemporary interest involving man-machine-environment interface. Class discussion and analysis of research and theory, with special focus on human factors aspects of systems design and operation.

Typically offered in Fall only

ISE 796 Research Practicum in Human-Systems Engineering (3 credit hours)
Human-systems engineering research topic development, literature evaluation, experimental design, use of research instrumentation, data collection, basic data interpretation, statistical analysis, manuscript preparation.

Typically offered in Spring only

ISE 801 Seminar (1 credit hours)
Seminar discussion of industrial engineering problems for graduate students. Case analyses and reports.

Typically offered in Fall and Spring

ISE 812/MA 812 Special Topics in Mathematical Programming (1-6 credit hours)
Study of special advanced topics in area of mathematical programming. Discussion of new techniques and current research in this area. The faculty responsible for this course select areas to be covered during semester according to their preference and interest. This course not necessarily taught by an individual faculty member but can, on occasion, be joint effort of several faculty members from this university as well as visiting faculty from other institutions. To date, a course of Theory of Networks and another on Integer Programming offered under the umbrella of this course. Anticipation that these two topics will be repeated in future together with other topics.

Prerequisite: IE(MA,OR) 505
Typically offered in Spring only

ISE 816/MA 816 Advanced Special Topics Sys Opt (1-6 credit hours)
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.

Typically offered in Fall and Spring

ISE 837 Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Typically offered in Fall, Spring, and Summer

ISE 839 Advanced Directed Study in Industrial Engineering (1-3 credit hours)
Independent study providing an opportunity for individual graduate students to explore advanced topics of special interest under the direction of a member of the faculty.

Typically offered in Fall, Spring, and Summer

ISE 861 The Design of Production Systems (3 credit hours)
The structure and operation of production planning, scheduling and control systems; emphasis on system structure, capacity planning, master production scheduling, shop loading and supply chain; investigation of current trends.

Typically offered in Fall only

ISE 877 Industrial Engineering Projects (1-6 credit hours)
Investigation and written report on assigned problems germane to industrial engineering. Maximum of six credits to be earned for MIE degree.

Prerequisite: MIE candidates
Typically offered in Fall, Spring, and Summer

ISE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ISE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ISE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Industrial Design (ID)

ID 102 Basic Industrial Design Studio (6 credit hours)
This course is a continuation of the work introduced in D104 with a focus on the industrial design discipline. This studio course examines the techniques and attitudes for dealing with exploration, identification, prototyping, evaluation and communication of problems and solutions arising from the design of physical artifacts in the natural and product environment. The design studio process includes the acquisition of languages and skills appropriate to creativity, design thinking, industrial design vocabulary and disciplined work habits.

Prerequisite: D104 and ID 110 Corequisites: ID 210 and ID216
Typically offered in Spring only

ID 110 Introduction to Digital Techniques (3 credit hours)
Introduction to the computer as a design tool for generating and manipulation of two-dimensional raster and vector imagery; techniques in two-dimensional concept rendering; 2D applications for design and production of presentation documentation; and an introduction to basic 3D digital techniques. Industrial design majors, department approved minor, and department approved elective for all other college of design majors.

Corequisite: D 104
Typically offered in Fall only

ID 201 Industrial Design Studio I (6 credit hours)
This course is an introduction to the theories, methods, and language of industrial design; elementary problems in form and function; transitional implications of hand-crafted and mass-produced objects in various materials. Industrial Design majors, and department approved elective ("swing") studio for all other College of Design majors.

Prerequisite: D 104 and ID 102 and ID 210 and ID 216; Corequisite: ID 310 and ID 316
Typically offered in Fall only

ID 202 Industrial Design Studio II (6 credit hours)
Introduction to the fundamentals of product development and design with emphasis on analytical and intuitive approaches to problem solving, technical skills, manufacturing and structural considerations in design of simple products/systems.

Prerequisite: ID 201 and ID 310 and ID 316; Corequisite: ID 255 and ID 240
Typically offered in Spring only

ID 210 Intermediate Digital Techniques (3 credit hours)
Progression of digital experiences that expand upon and combine the intellectual and conceptual skills required for digital 3D design visualization. Emphasis on solving design problems through development and manipulation of 3D form within the virtual environment.

Prerequisite: ID 110 and D 104; Corequisite: ID 102 and ID 216
Typically offered in Spring only

ID 216 Visualization I (3 credit hours)
This course is an introduction to the ideation process of conceiving, developing and recording ideas two-dimensionally.

Prerequisite: D 104 and ID 110; Corequisite: ID 102 and ID 210
Typically offered in Spring only

ID 240 Human-Centered Design (3 credit hours)
Introduction to the spectrum of human physical and cognitive capabilities as they relate to user interaction with designed products and environments. Industrial Design Majors and Department approved Elective for all other College of Design Majors with Junior or Graduate standing in Major.

Junior standing or above
Typically offered in Spring only

ID 244 History of Industrial Design (3 credit hours)
This survey class focuses on the history of modern design from the world of Art Nouveau in 1900 to Contemporary Design. The emphasis falls squarely on the development of mass production and its alignment with the Modern movement, with elements drawn from the history of architecture and the fine arts. The Bauhaus (1919-1933) is examined in detail as is the growth of the industrial design profession in the US between 1927 and 1944, when the Society of Industrial Designers was formed. Postwar styling and consumerism in the US are examined in conjunction with the development of human factors, its early investigations and influence on design since 1955. Material culture issues are examined through visits to the Gregg Museum of Art & Design and its growing collection of industrial design. Postmodernism, Universal Design, and User Experience Design are examined in the contexts of their emergence and relevance to design today.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

ID 255 Contemporary Manufacturing Processes I (3 credit hours)
Introduction to mass production processes and their influences on design. Materials and manufacturing processes utilized in quantity production. Emphasis on materials comparison and process selection in relation to product function, form, safety, human factors and manufacturability. Industrial Design majors and department approved Elective for all other College of Design majors.

Prerequisite: ID 201 and ID 315; Corequisite: ID 202
Typically offered in Spring only

ID 256 Contemporary Manufacturing Processes II (3 credit hours)
Second course in mass production processes and their influences on design. Emphasis on relationships between materials and manufacturing process selection, products design, and business. Related topics include rapid prototyping, 3D printing, electronics, color theory, drawings, working with vendors and suppliers, and production documentation. Industrial Design Majors and Department approved Elective for all other College of Design Majors.

Prerequisite: ID 255
Typically offered in Fall only

ID 262 Professional Practice in Industrial Design (3 credit hours)
Issues and situations encountered in a design practice. Topics include patents, trademarks, contracts, basic marketing skills within corporations and in design consultancies.

Typically offered in Spring only

ID 292 Special Topics in Industrial Design (1-3 credit hours)
Topics of current interest in Industrial Design. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

ID 301 Industrial Design Studio III (6 credit hours)
This course provides individual and team-oriented design experiences that expand upon and combine intellectual and manual skills required for the practice of industrial design. Intermediate level integration of computer technology, including 3D digital modeling, rapid prototyping, interactive virtual product visualization. Emphasis on identifying and solving design problems through manipulation of design theory, ecological/environmental concerns, advanced materials and manufacturing techniques.

Prerequisite: ID 202 and ID 255 and ID 240; Corequisite: ID 340
Typically offered in Fall only

ID 302 Industrial Design Studio IV (6 credit hours)
This course provides individual and team-oriented design experiences that expand upon and combine intellectual and manual skills required for the practice of industrial design. Continuity and increased complexity of project categories from the previous semester, developed through advanced use of digital technology. Emphasis is placed on identifying and solving design problems through manipulation of design theory, application of human factors, product safety awareness, universal design principles and digital presentation of concepts.

Prerequisite: ID 301; Corequisite: ID 440
Typically offered in Spring only

ID 310 Advanced Digital Techniques (3 credit hours)
Methods and techniques for developing 3D digital models and animations that are compelling, unique, and relevant in the creative process of Industrial Design. Students begin to strategically integrate 3D digital technology as part of the larger curriculum relative to studios and support classes and are encouraged to look beyond current conventions to find new means of creating digital artifacts.

Prerequisite: ID 210
Typically offered in Fall only

ID 316 Visualization II (3 credit hours)
This course expands the ideation process of conceiving, developing and recording ideas two-dimensionally, placing greater emphasis on the creative development and recording of the design process.

Prerequisite: ID 216; Corerequisite: ID 310
Typically offered in Spring only

ID 340 Research Methods in Industrial Design (3 credit hours)
This class provides an overview of the role of human centered design research throughout the stages of the design process. Students will use primary and secondary sources to place people at the center of the design inquiry process and gain insights about people's needs and desires within the context of industrial design.

Prerequisite: ID 240 and ID 202; Corequisite: ID 301
Typically offered in Fall only

ID 401 Advanced Industrial Design Studio I (6 credit hours)
This course is an advanced studio experience that expands upon the intellectual, digital, and practical skills required of an industrial design practitioner. Emphasis on identifying and solving design problems through manipulation of design theory, application of human factors, product safety awareness, appropriate combination of materials and manufacturing techniques, and presentation of concepts.

Prerequisite: ID 302 and ID 440
Typically offered in Fall only

ID 402 Advanced Industrial Design Studio II (6 credit hours)
This course is the second advanced studio that expands upon and combine the intellectual, digital, and practical skills required of an industrial design practitioner. This is a capstone experience where the outcomes, in the form of product proposals, reflect synthesis of design research, problem framing, and solution of complex design problems. Students achieve these outcomes through as mastery and manipulation of design theory, the application of human factors, an awareness of product safety, and appropriate combination of materials and manufacturing techniques. An emphasis is placed on the presentation and communication of processes and concepts.

Prerequisite: ID 401
Typically offered in Spring only

ID 440 Experience Design for ID (3 credit hours)
This course explores the theory and practice of the user-experience (UX) development process in the context of Industrial Design (ID). Students will clearly identify principles and professional processes for research, development, documentation and implementation of various stages of work, including requirements analysis, user needs analysis, prototyping, mockups, and production as these relate to industrial design best practices.

Prerequisite: ID 301 and ID 340; Corequisite: ID 302
Typically offered in Spring only

ID 490 Industrial Design International Studio (6 credit hours)
Define industrial design problems and develop design solutions in an international setting. Studio projects related to design, culture, and traditional and contemporary limited and mass produced products. Focus on artifact making through directed studies. Industrial Design Majors, and Department approved Elective ("swing") Studio for all other College of Design Majors with Junior or Graduate standing in Major.

Prerequisite: Junior standing in Major, Approval of Study Abroad Office
Typically offered in Summer only

ID 492 Special Topics in Industrial Design (1-3 credit hours)
Topics of current interest in Industrial Design. Normally used to develop new courses. Industrial Design Majors, and Department approved Elective for all other College of Design Majors with Junior, Senior or Graduate standing in Major.

Junior standing or above
Typically offered in Fall, Spring, and Summer

ID 494 Internship in Industrial Design (1-6 credit hours)
Supervised field experience in product design offices, galleries, museums and other related organizations. Maximum of 6 credit hours. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing, 3.0 GPA or better. Instructor Consent.
Typically offered in Fall, Spring, and Summer

ID 495 Independent Study in Industrial Design (1-3 credit hours)
Special projects in industrial design developed under the direction of a faculty member on a tutorial basis. Maximum 6 credit hours - May be repeated. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in Industrial Design and 3.0 GPA or better. Instructor Consent.
Typically offered in Fall, Spring, and Summer

ID 500 Advanced Industrial Design (Series) (6 credit hours)
Advanced studies in industrial design. Special emphasis given to problem identification, program formulation and application of advanced design methods. All problems of an individual nature leading to a synthesis of previous design experience.

Prerequisite: Portfolio review
Typically offered in Fall and Spring

ID 511 Industrial Design Materials and Processes I (3 credit hours)
Analysis of paper, wood, metal and manufacturing processes utilized in production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis on material search and process selection in relation to product safety, cost, function, human factors, form, finishes and joining methods.

Prerequisite: Graduate standing
Typically offered in Spring only

ID 512 Industrial Design Materials and Processes II (3 credit hours)
Analysis of plastics and rubber and related manufacturing processes utilized in production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis on material search and process selection in relation to cost, product safety, function, human factors, form, finishes and joining methods.

Prerequisite: Graduate standing
Typically offered in Fall only

ID 521 Graduate ID Studio I (6 credit hours)
Track III MID introduction to the theories, methods, and language of industrial design; elementary problems in form and function; and transitional implications of hand-crafted and mass-produced objects, in various materials and media. This course is open to Track III MID graduate students. This course is a prerequisite for ID 522 Graduate Studio II.

Corequisite: ID 531 and ID 541
Typically offered in Fall only

ID 522 Graduate ID Studio II (6 credit hours)
Track III MID continued introduction to the fundamentals of product development and design with emphasis on analytical and intuitive approaches to problem solving, technical skills, manufacturing, and structural considerations in design of simple products/systems. This course is open to Track III Master of Industrial Design graduate students.

Prerequisite: ID 521; Corequisite: ID 532 and ID 542
Typically offered in Spring only

ID 531 Product Visualization I (3 credit hours)
Track III MID introduction to the ideation process of conceiving, developing and recording ideas two-dimensionally. This course is open to Track III Master of Industrial Design graduate students. This course is a prerequisite for ID532 Product Visualization II.

Typically offered in Fall only

ID 532 Product Visualization II (3 credit hours)
This is an advanced course which expands the ideation process of conceiving, developing and recording ideas two-dimensionally, placing greater emphasis on the creative development and recording of the design process. This course is open to Track III Master of Industrial Design graduate students. Successful completion of ID 531 Product Visualization I is a prerequisite for this course.

P: ID 531
Typically offered in Spring only

ID 541 Product Digital Techniques I (3 credit hours)
Track III MID introduction to the computer as a design tool for generating and manipulation of two-dimensional raster and vector imagery; techniques in two-dimensional concept rendering; 2D applications for design and production of presentation documentation; and an introduction to basic 3D digital techniques. This course is open to Track III Master of Industrial Design graduate students and is a prerequisite for ID 542 Product Digital Techniques II.

Typically offered in Fall only

ID 542 Product Digital Techniques II (3 credit hours)
Methods and techniques for developing 3D digital models and presentations that are compelling, unique, and relevant in the creative process of Industrial Design. Students begin to strategically integrate 3D digital technology as part of the larger curriculum relative to studios and support classes and are encouraged to look beyond current conventions to find new means of creating digital artifacts. This course is open to Track III Master of Industrial Design graduate students.

P: ID 541
Typically offered in Spring only

ID 552 Human Factors in Design (3 credit hours)
This course is an introduction to the spectrum of human physical and cognitive capabilities as they relate to user interaction with designed products and environments. Emphasis is placed on designers making conscious design decisions regarding useful, usable, and desirable product, systems, and service attributes.

P: Graduate Standing
Typically offered in Spring only

ID 581 Industrial Design Project Preparation (3 credit hours)
A seminar course designed to assist students in preparing groundwork for the final project to be conducted in design studio.

Prerequisite: Graduate standing
Typically offered in Fall only

ID 582 Special Topics In Industrial Design (1-6 credit hours)
F,S. Topics of current interest to program/option offered by faculty in the School. Subjects offered under this number normally used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ID 588 Final Project Studio In Industrial Design (6 credit hours)
Final project for graduate students supervised by members of their graduate advisory committees.

Prerequisite: ID 581
Typically offered in Spring only

ID 630 Independent Study In Industrial Design (1-3 credit hours)
Special problems in various aspects of industrial design developed under the direction of faculty member on a tutorial basis. Students should complete Graduate Independent Study Proposal form prior to registration.

Prerequisite: Graduate Standing or Permission of the Instructor
Typically offered in Fall, Spring, and Summer

ID 676 Special Project (1-3 credit hours)
Seminars on subjects of current interest in industrial design which are presented by persons not part of regular faculty.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ID 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

ID 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

ID 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

ID 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Integrated Manufacturing Systems (IMS)

IMS 675 Manufacturing Systems Engineering Project (1-6 credit hours)
Individual or team project work in integrated manufacturing systems engineering resulting in an engineering report. Required of all degree candidates in IMSE master's program. Forms the basis for IMSE student's final oral examination.

Prerequisite: Graduate standing in IMSE
Typically offered in Fall, Spring, and Summer

IMS 680 Master's Directed Study (1-3 credit hours)
Independent study providing opportunity for individual students to explore topics of special interest under direction of a member of faculty.

Prerequisite: Graduate standing in IMSE
Typically offered in Fall, Spring, and Summer

IMS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

IMS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

IMS 696 Summer Project Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to project research.

Typically offered in Summer only

Interdisciplinary Perspectives (IPGE)

IPGE 295 Interdisciplinary Perspectives Special Topics (2-3 credit hours)
Special Topics course offered on a trial basis for the General Education Interdisciplinary perspectives category. Offered for a letter grade.

GEP Interdisciplinary Perspectives

Interdisciplinary Perspectives and Global Knowledg (IPGK)

IPGK 295 Interdisciplinary Perspectives and Global Knowledge Special Topics (2-3 credit hours)
Special topics course offering for the general education Interdisciplinary Perspectives and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Interdisciplinary Perspectives (IP) requirement.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

Interdisciplinary Perspectives and U.S. Diversity (IPUS)

IPUS 295 Interdisciplinary Perspectives and U.S. Diversity Special Topics (2-3 credit hours)
Special topics course offering for the general education Interdisciplinary Perspectives and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Interdisciplinary Perspectives (IP) requirement.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

Interdisciplinary Studies (IDS)

IDS 201 Environmental Ethics (3 credit hours)
Interdisciplinary consideration of ways in which field of study coupled with personal/cultural values contribute towards either solving or compounding environmental problems; provides framework for process of making ethical decisions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IDS 203/NR 203/PRT 203 Humans and the Environment (3 credit hours)
Solutions-focused examination of the varied, complex, and evolving frameworks used to make sense of how individuals & societies connect with the biophysical environment. Emphasis on current issues and relevance of interdisciplinary training to careers including environmental planning and policy, sustainable tourism, parks and recreation management, conservation, environmental education, and climate resilience. Topics include: population dynamics, public land and common resources, renewable natural resources, pollution, water resources, energy and non-renewable resources.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IDS 210 Introduction to American Studies (3 credit hours)
Introduction to the interdisciplinary study of American culture through exploration of questions asked and methods used in the field of American Studies. Will incorporate historical, literary, anthropological, and cultural studies approaches and methods for studying culture through texts, objects, and people. Topics to be considered include literary and popular texts, music, clothing, and historical and contemporary American experiences and cultures. Includes one field trip for which students will need to provide their own transportation.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Spring only

IDS 211 Eating through American History (3 credit hours)
Examination of cultural and scientific forces that have shaped our relationship with food. Science and politics of dietary recommendations. Influence, over time, of economic, social and political conditions on food preparation, preference and nutritional knowledge. Role of religion, family, tradition and personal experience in shaping eating attitudes and behaviors. Roles played only by women in American food culture.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

IDS 220 The Science and Art of Happiness (3 credit hours)
Interdisciplinary inquiry into the nature of happiness; why it matters, how to promote it, and what harms it. The relevance of the body-mind connection for one's happiness. Current scientific insights into happiness from physiology, neuroscience, and psychology, as well as their connections to Aristotelian ethics and to the concept of suffering in Buddhism. Experiential component of the course consisting of scientifically supported techniques for daily practice for deepening the understanding of course materials and discussions.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

IDS 295 Special Topics in Interdisciplinary Studies (1-12 credit hours)
Detailed investigation of an interdisciplinary topic. Topic and mode of study to be determined by faculty member and/or teach team.

Typically offered in Fall, Spring, and Summer

IDS 310 Animals in the Global Community (3 credit hours)
A lecture/seminar exploring the interdisciplinary field of Human Animal Studies in a global context, examining cultural, economic, ethical, ecological, geographical, political, and psychological aspects of human/nonhuman interactions using readings, films, and guest lectures. E.g. what are global ecological/political ramifications of treating cattle as sacred versus breeding them for beef? Why are there more tigers in captivity than in the wild? What are our ethical obligations to the Great Apes? Concepts such as place and placelessness, boundaries, animals as refugees, and interspecies justice will be explored. Course includes team work, and a research project focusing on personal area of interest. Junior Standing or higher.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall only

IDS 490 Interdisciplinary Methods and Issues (3 credit hours)
Capstone seminar for students in the IDS self-design major. Intensive study of student's area of concentration, leading to a major research paper.

Prerequisite: Interdisciplinary Studies Self-Design Majors, Senior standing
Typically offered in Spring only

IDS 495 Special Topics in Interdisciplinary Studies (1-12 credit hours)
Examination of selected topics of an interdisciplinary nature.

Typically offered in Fall and Spring

IDS 496 Topics in Film and Interdisciplinary Studies (3 credit hours)
Detailed examination of film within interdisciplinary contexts. Specific topics will vary from semester to semester.

IDS 498 Independent Study in Interdisciplinary Studies (1-12 credit hours)
Independent investigation and discussion of a selected topic of an interdisciplinary nature. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

International Studies (IS)

IS 200 Introduction to International Studies (3 credit hours)
Introductory analysis of the diverse processes of globalization, and an interdisciplinary survey of the social, political, economic, and cultural patterns reflected in the interrelations between various regions of the world. Emphasis on the historical and cultural contexts of debates in current global issues. A foundation course for students preparing an International Studies major or minor.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

IS 250 Globalizing North Carolina (3 credit hours)
Examines from an anthropological and historic perspective the impact of transnational and global forces on specific communities in North Carolina post World War II. Emphasis placed on studying the consequences of urban growth and economic shifts away from the agricultural and manufacturing industries and toward financial services, scientific and technological research, and the knowledge-based industries. Consequences include increased infrastructural demands, environmental issues, increased income and educational inequalities, food production, socio-cultural clashes, and migration and immigration concerns. Course requires students to visit 1 to 2 museums outside of class times.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

IS 301 International Cultural Competency before Study Abroad (1 credit hours)
Study abroad experiences are often instrumental moments in a student's personal and intellectual development, when someone may "connect the dots" between local and global issues for the first time in ways that are intimately unique to their own experience. This course provides students with a chance to meaningfully develop their international cultural competency before they embark on a study abroad experience.

Typically offered in Spring only

IS 393 Theories of Globalization (3 credit hours)
This course offers an in-depth and interdisciplinary examination of various aspects of globalization including economics, human dimensions of environmental change, culture, ethics and power. The course aims to build student understanding of the relationship between theory and application in the field of international studies. This course is designed for international studies minors, as well as majors who are expected to bridge between introductory materials and capstone coursework.
Restriction: Minimum of 45 credit hours complete; IS majors and minors only

Prerequisite: IS 200
Typically offered in Fall and Spring

IS 395 Special Topics in International Studies (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

IS 471/ANT 571/ANT 471 Understanding Latino Migration (3 credit hours)
This collaborative, hands-on class examines what ultimately drives migration and how families, communities, and policy-makers respond to migration in ways that can keep the process going. Focusing on emigration from Mexico, Guatemala, Honduras, and El Salvador, the course reviews the historical foundation for today's migration with attention to migration to North Carolina.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

IS 491 Senior Seminar in International Studies (3 credit hours)
An intensive study of selected international issues, global dimensions and implications, leading to a major research paper.

Prerequisite: IS 393
Typically offered in Fall and Spring

IS 495 Advanced Special Topics in International Studies (3 credit hours)
Detailed investigation of an advanced topic in International Studies. Topic and mode of study to be determined by faculty member.

Typically offered in Fall, Spring, and Summer

IS 498 Independent Study in International Studies (1-6 credit hours)
Independent Study of a topic in International Studies. Mode of study determined by a faculty member and student(s). Independent Study courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" to be completed by the student(s) and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

International Studies (MIS)

MIS 598 Special Topics in International Studies (1-6 credit hours)
In-depth investigation of a contemporary topic in the field of international studies in a class context. Topic and mode of instruction to be determined by faculty member. May be taken for up to six hours of credit.

Prerequisite: Advanced Undergraduate standing, PBS status, or Graduate standing
Typically offered in Fall, Spring, and Summer

MIS 601 Colloquium in International Studies (3 credit hours)
Selected topics in international studies required for writing and oral presentation of MIS capstone paper.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MIS 630 Independent Study (1-3 credit hours)
Investigation of topics of particular interest to advanced students under faculty direction on a tutorial basis. Credits and content vary with student/faculty discretion and needs.

Restricted: MIS Students Only
Typically offered in Fall, Spring, and Summer

MIS 651 Internship in International Studies (1-6 credit hours)
Exposure of student to value systems and technological environment of cultures other than his/her own through a supervised work experience. Application of technological knowledge to development problems. Required technical paper summarizing and analyzing this experience.

Prerequisite: MIS standing
Typically offered in Fall, Spring, and Summer

MIS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

MIS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

MIS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

Landscape Architecture (LAR)

LAR 200 Landscape Architecture Introductory Studio (6 credit hours)
Small scale landscape architectural design. Site observation exercises and visits, physical design projects, reading and discussion. Basic skills in landscape architecture, discerning the environmental issues in design, understanding design process, drawing and verbally communicating issues, and idea conceptualization and realization.

Prerequisite: Design Majors and D 104
Typically offered in Fall only

LAR 210 Digital Drawing for Landscape Architecture (3 credit hours)
Digital modeling and computer aided design in landscape architecture. Integration of digital data in visualization of past, existing and future designs.

Prerequisite: LAR Majors
Typically offered in Fall only

LAR 211 Digital Design Media for Landscape Architecture (3 credit hours)
Principles and practices related to the use of digital applications in landscape architectural design. Includes two-dimensional raster imaging, vector graphics, photo simulation, and three-dimensional modeling.

Prerequisite: LAR Majors
Typically offered in Spring only

LAR 221 Introduction to Environment and Behavior for Designers (3 credit hours)
Integration of behavioral and environmental systems related to design. Exploration of humane, ecologically sound design alternatives.

GEP Humanities
Typically offered in Summer only

LAR 222 Perception and Behavior for Designers (3 credit hours)
Perceptual systems, linkages among them, and linkages between them and language and culture as these affect the design process.

Typically offered in Spring only

LAR 292 Special Topics in Landscape Architecture (1-3 credit hours)
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

LAR 400 Landscape Architecture Studio (6 credit hours)
Projects cover small scale design, urban landscapes, community design, and environmental management. Design process stressed, including attention to project organization, design synthesis and realization.

Prerequisite: D 105, LAR 200; or Departmental Head Approval
Typically offered in Spring only

LAR 430 Site Planning (3 credit hours)
Technical operations and environmental landscape controls for site development. Site analysis, grading and drainage, earthwork, horizontal and vertical control for road alignment. Graphic exercises.

Prerequisite: LAR 400 or LAR 501
Typically offered in Spring only

LAR 444 History of Landscape Architecture (3 credit hours)
The history of designed landscapes. Environmental, social and cultural factors which influence human made landscapes presented with history and art of landscape architecture.

GEP Visual and Performing Arts
Typically offered in Fall only

LAR 445 Sustainable Design and Development (3 credit hours)
This online, asynchronous course focuses on the global, regional and local environmental and social impacts of development. We explore sustainable design and development strategies and examine exemplary case studies in the following areas: climate change; ecosystems; water systems; food systems; material, resource and waste systems; building and energy systems; and cities and communities. Select UN Sustainable Development Goals provide a framework for this course and allow us to examine issues of equity as they relate to these goals.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

LAR 457 Landscape Construction Materials, Methods and Documentation (3 credit hours)
Materials, standards, and construction methods used to implement landscape architectural designs. Development of construction documents.

Prerequisite: LAR 400 or LAR 502
Typically offered in Summer only

LAR 465 Landscape Architecture International Studio (6 credit hours)
Define landscape architectural problems and develop design solutions in an international setting. Exercises and projects related to design, culture and the physical environment of the host country. Focus on landscape architecture, gardens and urbanism studied through sketching and documentation, discussion, site investigation, historical context, current design examples and design applications.

Prerequisite: Junior Standing in the College of Design and Approval of the International Study Abroad Office.
Typically offered in Spring only

LAR 492 Special Topics in Landscape Architecture (1-3 credit hours)
Topics of current interest in Landscape Architecture. Normally used to develop new courses.

Typically offered in Fall, Spring, and Summer

LAR 495 Independent Study in Landscape Architecture (1-3 credit hours)
Individual projects in landscape architecture developed under the direction of a faculty member on a tutorial basis. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in Landscape Architecture 3.0 GPA or better
Typically offered in Summer only

LAR 500 Landscape Design Studio (6 credit hours)
Application of information and skills developed in course work to environmental design problems. Process of site selection, activity programming, site planning and program evaluation followed employing creation of interactive communication systems between designer, clients and users. Goals include design of satisfying new landscapes as well as conservation and design strategies for existing culturally important landscapes and townscapes.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

LAR 501 Landscape Architecture Introduction Design Studio (6 credit hours)
Introduction to landscape architectural design thinking processes and applications that include: site analysis, post occupancy user studies, programming, site planning, graphic representation (drawing, model making, digital graphics), verbal communication, and criticism and reflection.

Typically offered in Fall only

LAR 502 Site Design and Environmental Planning Studio (6 credit hours)
Strategies, principles, and methods for designing and evaluating resilient ways and means to fit an intensive development program(s) on environmentally challenging, regionally specific sites. This design studio is integrally linked with courses LAR 527- Landform, Grading and Environmental Site Systems and LAR 520- Environment and Culture.

Prerequisite: LAR 501
Typically offered in Spring only

LAR 503 Landscape Architecture Design Development & Construction Documentation Studio (6 credit hours)
Site planning design refinement from conceptual schematic design through to the preparation of technical landscape architectural construction plans and details.

Prerequisite: LAR 501 and LAR 502 or permission of Department Head of DGP.
Typically offered in Fall only

LAR 504 Landscape Architecture International Design Studio (6 credit hours)
Application of design thinking processes in landscape architectural design situations resident within a host international urban venue. This is a studio course for Landscape Architecture students studying abroad.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.
Typically offered in Fall only

LAR 505 Landscape Architecture Final Project Studio (6 credit hours)
Individual semester long projects demonstrating capabilities in a full range of design and production skills.

Typically offered in Fall and Spring

LAR 506 Landscape Architecture Design + Build Studio (6 credit hours)
Design and construction implementation of sustainable construction practices for a low impact landscape system installation that responds to degraded environmental conditions.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.
Typically offered in Spring only

LAR 507 Advanced Topics Studio in Landscape Architecture and Environmental Planning (6 credit hours)
Advanced engagement, emphasizing research, development and application of experimental and best practices, on current and emerging landscape architectural and environmental planning topics of increased complexity. Advanced Topics Studios in LA and Env Plng integrate, apply, and reinforce materials including history and theory, site works, modeling and representation, research methods, environmental analysis, and professional practice delivered in LAR subject area courses.

Prerequisite: LAR 502 or department head or DGP consent.
Typically offered in Fall and Spring

LAR 508 Landscape Architecture Design Research Project (6 credit hours)
Independent research in a specific area of landscape architectural design with the requirement that the research be integrated and applied within a landscape architectural design context; provides opportunities for a student or team of students (up to 4 people) to engage in independent inquiry leading to the completion of a definitive scholarly, research-oriented landscape architectural design project. Requires consent of department head or DGP.

Prerequisite: LAR 507 and LAR 541 and LAR 697 or department head consent.
Typically offered in Fall, Spring, and Summer

LAR 509 Landscape Architecture Design Fundamentals (3 credit hours)
Introduction to the language, topics, and processes associated with landscape architectural design and the means used to envision and transform ideas into physical form in the landscape.

Typically offered in Summer only

LAR 510 Introduction to Landscape Architectural Drawing Applications (3 credit hours)
Introduction to fundamental drawing principles and methods utilized in landscape architectural design and representation applications. Topics covered include: freehand sketching, field observation diagrams and sketches, freehand and constructed perspectives, plan and section view drawings, shade and shadow, color, design process drawings, and presentation layout.

Typically offered in Summer only

LAR 513 Landscape Architecture Digital Media 1 (3 credit hours)
Introduction to the principles and practices related to the use of 2D and 3D digital media in landscape architectural design representation and communication applications.

Typically offered in Summer only

LAR 514 Landscape Architecture Digital Design Media 2 (3 credit hours)
Digital modeling and representation methods, applications and production using two and three-dimensional digital design media; this course is integrally linked with LAR 501, Landscape Architecture Introduction Design Studio.

Prerequisite: LAR 513 or instructor or department head, or DGP consent
Typically offered in Fall only

LAR 515 Advanced Landscape Architecture Digital Design Media (3 credit hours)
Advanced digital media tools and techniques to create and refine routines used in landscape architectural modeling and representation applications.

Prerequisite: LAR 513 and LAR 514 or consent of Department Head or DGP.
Typically offered in Fall only

LAR 517/GIS 517 GIS Applications in Landscape Architecture and Environmental Planning (3 credit hours)
Introduction to the methods and applications of geographic spatial modeling technology in landscape architecture and environmental planning.

Typically offered in Fall only

LAR 520 Environment and Culture (3 credit hours)
An integrative approach to human and natural systems, specifically the dynamic social and ecological forces that act upon, modify, and give meaning to landscapes.

Typically offered in Fall only

LAR 521 Values, Theory and Methods of Landscape Architecture (3 credit hours)
Radical change in profession of landscape architecture in the past decade. New and emerging roles for landscape architect include regional analysis, landscape assessment, land development, urban planning, recreation planning, etc. Development of core values and theories from which each emerged and survey of the techniques and methods of their development.

Prerequisite: Graduate standing
Typically offered in Fall only

LAR 523 Landscape Architecture Plant Identification (2 credit hours)
Introduction to the vocabulary and methods necessary to identify ornamental and native plants in the built and natural landscape. The course is structured around the understanding of the taxonomic tools necessary to identify plants.

Typically offered in Summer only

LAR 524 Planting Design Applications in Landscape Architecture (2 credit hours)
Introduction to theories, practices, and implications associated with the diverse uses of plants in landscape architectural design applications considerate of functional, ecologic, aesthetic, economic, maintenance, health, safety, welfare, and other factors.

Prerequisite: LAR 501 and LAR 502 or permission of Department Head of DGP.
Typically offered in Summer only

LAR 525 Landscape Architecture Field Studies (3 credit hours)
On-site observation and assessment of constructed landscape architectural projects focused on historic and contemporary design practices that promote environmental health, safety, wellbeing, and beauty through industry defined practices.

Typically offered in Fall only

LAR 527 Landform, Grading, and Environmental Site Systems (3 credit hours)
Introduction to landform representation, grading, environmental site systems, and best practices required in landscape architectural site design and environmental planning applications.

Prerequisite: LAR 501 or consent of instructor or department head or DGP.
Typically offered in Spring only

LAR 528 Landscape Architecture Construction Materials and Methods (3 credit hours)
Introduction to landscape architectural construction materials, methods, documentation, and implementation practices including best professional practices, and current and emerging technologies.

Prerequisite: LAR 501 and LAR 502 and LAR 527 or permission of department head or DGP.
Typically offered in Fall only

LAR 534 Landscape Architecture Theory and Criticism (3 credit hours)
Introduction to the pervasive principles, concepts, movements, and applications influencing landscape architectural planning and design.

Prerequisite: LAR 501 and LAR 502 and LAR 520 or consent of Department Head or DGP.
Typically offered in Fall only

LAR 535 Environmental Social Equity and Design (3 credit hours)
Principles of environmental justice and social equity in the context of design and community engagement; focus on the trends affecting environmental and human health in the built environment.

Typically offered in Spring only

LAR 540 Research Methods in Landscape Architecture and Environmental Planning (3 credit hours)
An overview of the role of research in landscape architecture and environmental planning with introductions to systematic inquiry that help to understand the complex relationships between people and their environment. The course explores different tools and approaches for answering research questions and translating research findings into usable strategies and environmental design solutions.

Typically offered in Spring only

LAR 542 Human Use of the Urban Landscape (3 credit hours)
Urban environment-behavior field research methods at site planning scale (behavior and cognitive mapping, interview and survey methods, archival research), suitable for application in practice. Methods of integrating user needs into design programming using participatory approaches. Evidence-based design applied to residential neighborhood, health, education, and recreation settings. Research activities conducted in small groups. No required texts. Overnight, weekend field trip at student expense.

R: Masters students at NCSU, UNC-CH, or Duke University. Upper level undergraduate students are allowed with permission of the instructor.
Typically offered in Spring only

LAR 543 Landscape Performance and Metrics (3 credit hours)
Concepts, tools and methods, and research to measure and integrate considerations of landscape performance including environmental, economic/life cycle, management, social, and aesthetic factors in landscape architectural applications.

Typically offered in Spring only

LAR 544 Contemporary Issues in Landscape Preservation (3 credit hours)
An examination of how local governments organize themselves to deal with the conservation and protection of areas of acknowledged cultural value or scenic/aesthetic character as well as the respective roles of federal, state, and local governments in these efforts. Particular attention will be given to understanding the recent past in preservation efforts.

Typically offered in Fall only

LAR 545 City Planning and Design - Building Great Communities (3 credit hours)
This course explores the history and heritage of city planning and design in an ever-urbanizing world, the legal underpinning and practice of the tools of planning in the US - comprehensive planning, zoning, infrastructure planning and design guidelines, environmental and social challenges for an urban planet, and the procurement of planning and design services, both from the perspective of the hiring entity as well as from that of the consultant.

Typically offered in Spring only

LAR 546 The Landscape Imperative (3 credit hours)
Exposure to the complex interrelationships of demographics, resource stewardship and land development in terms of the issues, questions, challenges and opportunities for landscape architects and urban designers.

Typically offered in Spring only

LAR 547 Greenway Planning and Design (3 credit hours)
Exposure to complex interrelationships in the planning, design, development and operations of greenway corridors and systems, including natural systems evaluation, community planning, public engagement, preparation of construction documents, construction administration, business practices, regulatory issues, legal framework, programming and funding.

Typically offered in Fall only

LAR 550 Landscape Architecture Professional Practice (3 credit hours)
Exposure to the range of practice opportunities in landscape architecture with an overview of career opportunities in the public (Federal, State, and Local) and private sectors as well as in non-traditional and emerging roles.

Typically offered in Spring only

LAR 552 Survey of Natural Hazards and Disasters (3 credit hours)
This survey course provides a graduate level introduction to the broad fields of study associated with natural hazards and disasters. Emphasis is placed on gaining an understanding of the defining characteristics of natural hazards and how their effects on human settlements can lead to a series of issues that help us understand what defines a disaster. This course introduces students to a range of topics including meteorology, geology, hydrology, engineering and building performance, policy making, planning, and sociology, among other disciplines. The course is framed using concepts of sustainable development and disaster resilience, including those pre- and post-disaster conditions and actions that enhance or hinder these aims. Emphasis is placed on the use of case studies of past disasters to help students understand the physical characteristics of natural hazards and how individual, community, state, regional, national and international actions led to the event becoming a disaster.

Typically offered in Fall only

LAR 554 Disaster Resilient Policy, Engineering and Design (3 credit hours)
This course addresses the interdisciplinary (policy, engineering and design) study and practice of disaster resilience. Emphasis is placed on the critical review of existing policies, programs and approaches taken that have led to increased levels of exposure to natural hazards, growing levels of social vulnerability and exponentially rising disaster losses. In an era of climate change, these issues are explored relative to the need to enhance adaptive capacity through sound policy, engineering and design. Class lectures, readings and student/faculty discussions help to advance each student's knowledge of the subject matter and provide relevant background information to inform interdisciplinary class projects.

No prerequisites for graduate students. Undergraduate students may petition to take this graduate course. Preference given to graduate students pursuing the proposed graduate certificate titled Disaster Resilient Policy, Engineering and Design
Typically offered in Spring only

LAR 565 International Landscape Architecture Design Studio (6 credit hours)
Landscape architectural problems and design solution in international setting. Exercises and projects related to design, culture and physical environment of host country. Focus on landscape architecture, gardens and urbanism through sketching and documentation, discussion, site investigation, historical context, current design examples and design applications.

Prerequisite: Graduate standing the College of Design and approval of the International Study Abroad Office
Typically offered in Fall only

LAR 582 Special Topics In Landscape Architecture (1-6 credit hours)
Topics of current interest to programs in School of Design offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

LAR 607 Natural Hazards, Disasters and Climate Change Adaptation Lecture Series (1 credit hours)
Invited practitioners and scholars will discuss a range of contemporary topics (bi-weekly) tied to natural hazards, disasters and climate change adaptation, including research findings, experience in practice, and the translation of knowledge to action. Speakers are drawn from federal, state, and local jurisdictions; scholars from pertinent fields of study, including physical and social scientists; private sector representatives, including corporations, insurance officials, developers, and consultants; members of the media; politicians; environmental and social justice advocates; community leaders; members of various professional associations; and others as identified. Emphasis will be placed on the role of design, broadly defined, to enhance resilience to slow- and rapid onset natural hazards and disasters, including those caused or exacerbated by a changing climate. Preference will be given for students pursuing the graduate certificate Disaster Resilient Policy, Engineering and Design once approved. Undergraduates may petition to take course.

P: Graduate Standing
Typically offered in Spring only

LAR 630 Independent Study (1-3 credit hours)
Special problems in various aspects of design developed under direction of a faculty member on a tutorial basis.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

LAR 650 Internship in Landscape Architecture (3 credit hours)
Supervised field experience in a professional landscape architecture office, related design office, or governmental agency.

Prerequisite: LAR 501 and LAR 502 and LAR 503 or department head or DGP consent.
Typically offered in Fall, Spring, and Summer

LAR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

LAR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall and Spring

LAR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall and Spring

LAR 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

LAR 696 Summer Thesis Res (1 credit hours)

LAR 697 Design Research Project Independent Study (3 credit hours)
Advanced Independent study under taken by 1-4 students leading to the preparation of the Project Proposal, as a prerequisite for undertaking LAR 508-Design Research Project. (Permission to proceed with LAR 697 requires approval by department head or DGP and faculty mentor.)

Prerequisite: LAR 540 or approval from Department Head or DGP.
Typically offered in Fall, Spring, and Summer

LAR 896 Summer Dissert Res (1 credit hours)

Leadership in the Public Sector (LPS)

LPS 200 Introduction to Public Leadership (3 credit hours)
This introductory course is designed for students who are interested in exploring public sector leadership. Students will be introduced to fundamental concepts and assumptions of leadership, will evaluate methods for conducting adequate academic research on leadership, and will assess skills and approaches for good public and non-profit sector leadership, with a focus on leadership self-assessment.

Typically offered in Fall, Spring, and Summer

LPS 201 The Humanitarian Response to Conflict (3 credit hours)
LPS 201 offers up an introduction to the ideals and paradoxes of humanitarian intervention, with a special emphasis on military responses to humanitarian crises. This course explores the history, animating ideals and contemporary paradoxes of humanitarian action and related military interventions. Throughout history and ever increasingly in the present, there is an intersection between military and humanitarian operations in conflict zones.

Typically offered in Fall, Spring, and Summer

LPS 202 Essentials of Fundraising for Leaders in Public and Non-Profit Institutions (3 credit hours)
The course covers the basics of fundraising for public and non-profit agencies which include the agencies history, board development, event planning, and the motivation of the giver. In addition, the students will learn the elements of grant proposals related to public sector agencies. The work will include case studies, weekly lectures, discussion assignments, final exam and a special event planning proposal.

Typically offered in Fall only

LPS 205 International Leadership in Global Politics (3 credit hours)
Perspectives on leadership dilemmas and strategies in a globalized, knowledge-based, network-dependent environment. Challenges of state and nation-building abroad. Trans-border policy concerns for the national, state, and local governments. Applications of soft power and public diplomacy. International interactions of non-profit and non-governmental organizations. International aspects of informal and grass roots activism.

Typically offered in Fall only

LPS 210 LPS Career Development (1 credit hours)
This course is designed for senior status LPS students who are considering a career change and are interested in exploring job opportunities related to the public sector field. Students will learn about their personal strengths, values, skills, and understand how these self-assessments will affect their career choices. Explorations of these areas include specific emphasis on developing and refining interviewing skills, professional and personal networks, and job application and selection.

Restriction: LPS Senior Status Only
Typically offered in Spring only

LPS 302 Diversity and Leadership in the Public Sector (3 credit hours)
This course provides students with information regarding diversity and leadership in history as well as material and activities that foster an understanding of how diversity and leadership intersect in the public sector and how diversity can improve organizational effectiveness and performance. The concept of cultural competency is defined and evaluated as an important component of effective public sector leadership. Students will learn what it means to be a more culturally competent leader.

GEP U.S. Diversity
Typically offered in Fall and Spring

LPS 304 Grant Writing (3 credit hours)
The focus of this course is on obtaining grant funding for nonprofit and government organizations. This course covers the skills and strategies essential to the grants development process including basic strategies for researching funding sources and developing successful grant proposals.

Typically offered in Spring only

LPS 308 Terrorism, Political Violence and the Public Response (3 credit hours)
In this course, students will examine the phenomena of political conflict and terrorism in the modern world. We will examine these questions through a mix of theoretical readings and in-depth case studies of sectarian violence, terrorism, state failure and collapse, riots, and racial tensions commonly considered political conflict and terrorism. Students will learn the basic details of political violence and terrorism and understand the implications of these acts for those living in the region and the rest of the world. We will examine a range of armed violence globally and develop approaches to explain violence in different cases and context. Students will learn about the use of terror as a means of influencing public policy decisions and discuss the implications of counterterrorism policies at a societal and individual level.

Typically offered in Fall and Summer

LPS 315 Public Leadership (3 credit hours)
Nature and varieties of political leadership by elected and appointed officials in government, officials and volunteers in nonprofit organizations, and leaders of political movements and community groups. The course draws on literature in political science, self-assessment of student's leadership characteristics, and examination of outlets for political leadership activity.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

LPS 320 Research Methodology for the Public Sector (3 credit hours)
This course will teach students to investigate political and policy related questions in a systematic and scientifically rigorous fashion. Students will become familiar with the basic toolkit of social science methodology, practice basic data analysis, and develop a research project. They will acquire the skills essential for evaluating the claims of others and for advancing sound arguments of their own. This knowledge is applicable in a wide variety of organizational research, needs assessment, program and performance evaluation.

Typically offered in Fall, Spring, and Summer

LPS 398 Special Topics in Leadership in the Public Sector (3 credit hours)
For topics not part of regular course offerings, or offering of new courses on a trial basis. May be taken up to three times provided the topics are different.

Typically offered in Fall, Spring, and Summer

LPS 400 Decisive Leadership (3 credit hours)
Decisive Leadership is a challenging course that will study, practice, and apply the fundamentals of leadership, values and ethics, personal development, decision-making, influencing and motivating others and team tactics in problem solving and mission accomplishment. Military officers, especially, enrolled in the LPS program will gain immediate benefit from the leadership self-assessments and new leadership strategies.

Typically offered in Fall and Summer

LPS 425 Leadership in the Public & Nonprofit Sectors Capstone (3 credit hours)
Leadership is a critical topic in public, nonprofit, and business administration. Leadership is what we expect of U.S. presidents, association directors, and CEOs, as well as of mid-level and frontline supervisors. Clearly, leaders are awarded the accolades when the organization succeeds and given the blame for its failures. But organizations succeed not just because of the top leader's actions; a positive leadership climate that pervades the organization helps it to learn, adapt, and perform at a high level. Only LPS major students must complete LPS 200 Introduction to Public Leadership course prior to enrolling in LPS 425.

Prerequisite: LPS Majors need to have passed LPS 200
Typically offered in Spring only

LPS 490 Undergraduate Internship in Leadership in the Public Sector (1-3 credit hours)
Students can earn 1-3 credits for completing internships in the public sector or non-profit agencies. Emphasis is placed on gaining work experience needed to explore and plan careers in the public and non-profit sector. Students must prepare an internship proposal. Students must provide own transportation for internship. Intern liability insurance is required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: LPS 200
Typically offered in Fall, Spring, and Summer

Liberal Studies (MLS)

MLS 501 Seminar In Liberal Studies (3 credit hours)
Intensive study of an interdisciplinary issue or area. Seminars, varying each semester, address such topics as arts studies, history and literature, sociobiology and social sciences, world trade and world conflict, and technology and social change.

Prerequisite: Admission to M.A. in liberal studies
Typically offered in Fall, Spring, and Summer

MLS 630 Independent Study (1-3 credit hours)
Advanced independent study of an interdisciplinary topic under supervision of a faculty member.

Prerequisite: Admission to M.A. in liberal studies
Typically offered in Fall, Spring, and Summer

MLS 676 Independent Project (1-3 credit hours)
Advanced independent research on an interdisciplinary project under supervision of a faculty member.

Prerequisite: Admission to M.A. in liberal studies
Typically offered in Fall, Spring, and Summer

MLS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MLS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

Life Sciences First Year (LSC)

LSC 101 Critical and Creative Thinking in the Life Sciences (2 credit hours)
Through case studies and discussion-based classes, this course guides students through a metacognitive approach to (1) critical and creative thinking, (2) the nature and practice of science, (3) the rhetoric of science, and (4) the process of learning. This course will challenge students to apply the standards of critical and creative thinking in critiquing their own work and the work of others; guide students to an understanding and appreciation of the rhetoric of science; help students gain an understanding of fundamental principles of the nature and conduct of science within the life science disciplines; and encourage students to become active, engaged learners through an understanding of effective approaches to learning with an emphasis on the neurobiology of learning. Incoming freshmen admitted to the Life Sciences First Year Program (will open available seats to other FR in the spring semester section).

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

LSC 103 Exploring Opportunities in the Life Sciences (1 credit hours)
The overarching goal of this course is to help students create a solid foundation on which they can build to enhance their success in college and especially in their studies within the life sciences. Students will be challenged to think intentionally about how they will approach learning inside and outside the classroom and what factors might influence their college experience. Through this course, students will think about their transition from high school to college; identify campus resources and explore academic policies; research potential majors in the life sciences and potential minors; attend and reflect upon cultural and educational events across campus; and create a "plan for success" for their time at NC State. Cannot get credit for both LSC 103, and BCH 103, or MB 103, or PB 103. Restricted to incoming freshmen admitted to the Life Sciences First Year Program.

R: 11LSFY or 17LSFY
Typically offered in Fall and Spring

LSC 170 First Year Seminar in the Life Sciences (1 credit hours)
Topical problems in the life sciences. LSC 170 provides an opportunity for LSFY students to work in a small group setting with a faculty member to explore a topic within the faculty member's area of expertise. Emphasis will be placed on active, collaborative learning; effective communication skills; higher order cognitive skills; and applying the intellectual standards of critical thinking. Topics and instructors will vary from section to section and from semester to semester. Students can repeat LSC 170 once as long as the two sections are on different topics.

R: 11LSFY or 17LSFY
Typically offered in Fall and Spring

LSC 205 Class Assistant Experience (1 credit hours)
LSC 205 provides an opportunity for students to gain experience as Class Assistants within the Life Sciences First Year Program and to reflect on that experience as it relates to their own college experiences, personal growth, and professional development. Expectations, to be detailed in the LSC 205 contract, will include attendance at all LSC 205 class meetings, attendance at all class meetings of the section for which you are working as Class Assistant, and completion of written reflection assignments. Instructor consent required.

Typically offered in Fall only

LSC 295 Special Topics in Life Science (1-3 credit hours)
New courses offered on a temporary or trial basis for Life Sciences First Year students.

R: 11LSFY or 17LSFY
Typically offered in Fall, Spring, and Summer

Logic (LOG)

LOG 201 Logic (3 credit hours)
Introduction to methods of deductive inference. Concepts of inconsistency and entailment. Truth Functional Statement Logic and Quantifier and Predicate Logic. Representation of logically significant forms of statements and arguments. Construction of proofs using methods of natural deduction.

GEP Mathematical Sciences
Typically offered in Fall and Spring

LOG 335/MA 335 Symbolic Logic (3 credit hours)
Intermediate level introduction to modern symbolic logic focusing on standard first-order logic; topics include proofs, interpretations, applications and basic metalogical results.

Prerequisite: LOG 201 or MA 225 or CSC 226
GEP Mathematical Sciences
Typically offered in Fall only

LOG 430 Varieties of Logic (3 credit hours)
Study of various non-classical logics such as modal logic, many-valued logic, paraconsistent logic, second-order logic, and intuitionistic logic. Emphasizes their applications in fields such as philosophy, linguistics, mathematics, computer science, and artificial intelligence. Students cannot receive credit for both LOG 430 and LOG 530.

P: LOG 201 or LOG 335 or MA 335 or MA 225 or CSC 226
Typically offered in Spring only

LOG 435 Advanced Logic & Metamathematics (3 credit hours)
Advanced topics in logic and metamathematics: proof procedures, first-order theories, soundness and completeness theorems, recursive functions, the formalization of arithmetic, the Goedel Incompleteness Theorems. Emphasis on mathematical study of logic and mathematics. Students cannot receive credit for both LOG 435 and LOG 535

Prerequisite: LOG 335. Credit is not allowed for both LOG 435 and LOG 535.

LOG 498/LOG 598 Special Topics in Logic (1-6 credit hours)
Detailed investigation of selected topics in logic. Topics determined in consultation with head of the department. Course may be used for individualized study. Students cannot receive credit for both LOG 498 and LOG 598 unless the topic is different.

Prerequisite: One of the following: (MA/LOG 335, LOG 435, LOG 437, MA 403, MA 407, MA 408, MA 410, MA/CSC 416, MA 421, MA 425, MA 426, CSC 333, CSC 411, or CSC 417)
Typically offered in Fall and Spring

LOG 530 Varieties of Logic (3 credit hours)
Study of various non-classical logics such as modal logic, many-valued logic, paraconsistent logic, second-order logic, and intuitionistic logic. Emphasizes their applications in fields such as philosophy, linguistics, mathematics, computer science, and artificial intelligence. Students cannot receive credit for both LOG 430 and LOG 530.

Prerequisite: Graduate standing
Typically offered in Spring only

LOG 535 Advanced Logic and Metamathematics (3 credit hours)
Advanced topics in logic and metamathematics: proof procedures, first-order theories, soundness and completeness theorems, recursive functions, the formalization of arithmetic, the Goedel Incompleteness Theorems. Emphasis on mathematical study of logic and mathematics. Students cannot receive credit for both LOG 435 and LOG 535

Prerequisite: LOG 335. Credit is not allowed for both LOG 435 and LOG 535.

LOG 598/LOG 498 Special Topics in Logic (1-6 credit hours)
Detailed investigation of selected topics in logic. Topics determined in consultation with head of the department. Course may be used for individualized study. Students cannot receive credit for both LOG 498 and LOG 598 unless the topic is different.

Prerequisite: One of the following: (MA/LOG 335, LOG 435, LOG 437, MA 403, MA 407, MA 408, MA 410, MA/CSC 416, MA 421, MA 425, MA 426, CSC 333, CSC 411, or CSC 417)
Typically offered in Fall and Spring

Management Innovation Entrepreneurship (MIE)

MIE 201 Introduction to Business Processes (3 credit hours)
Cross-functional treatment of major activities of business, such as product design, distribution, production, and marketing. Description of specific tasks, via lectures and case studies, in support of major business activities. Interactions among various functional areas of business.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

MIE 295 Special Topics in MIE (1-6 credit hours)
Presentation of material at the 200-level not normally available in regular course offerings, or offering of new courses on a trial basis. Course may be taken multiple times only if topic is different.

Typically offered in Fall, Spring, and Summer

MIE 305 Legal and Regulatory Environment (3 credit hours)
Introduction to fundamental subfields, rules, and concepts of law that are regularly significant to business operations. Emphasis on the law of contracts, torts, property and intellectual property rights, business organizations, and agency. Includes principals of constitutional, administrative and criminal law in a business context, and issues of ethics, fiduciary duty, civil procedure and legal risk management generally. Credit is not allowed for both BUS 305 and MIE 305.

Typically offered in Fall, Spring, and Summer

MIE 306 Managing Ethics in Organizations (3 credit hours)
Management practices to define, communicate, and implement ethical conduct in business organizations. Normative and applied analysis of current ethical dilemmas of corporations in free markets, techniques for effective management of corporate social responsibility, and formulation and implementation of ethics management programs. College of Management majors only.

Prerequisite: MIE 201
Typically offered in Fall and Spring

MIE 310 Introduction to Entrepreneurship (3 credit hours)
Introduction to planning, formation, and management of entrepreneurial ventures. Fundamental business concepts and managerial skills applied to entrepreneurial ventures. Course projects support experiential learning of critical skills. Some individual off-campus travel is required.

Typically offered in Fall, Spring, and Summer

MIE 330 Human Resource Management (3 credit hours)
The systematic principles for managing the human resource component of organizations. Topics include: environmental influences on planning, recruitment, and selection; managing workforce diversity; developing effectiveness and enhancing productivity; compensation, benefits, and security; and strengthening employee-management relations.

Prerequisite:MIE 201, Sophomore standing
Typically offered in Fall, Spring, and Summer

MIE 335 Organizational Behavior (3 credit hours)
Survey of contemporary managerial applications for managing people in modern organizations. Topics include: motivation, group dynamics, team development, ethics, communications, organizational politics, leadership, power, organizational development, organizational design and structure. Current managerial issues include total quality management and technology management.

Prerequisite: 9 hrs. of social science or 6 hours of social science plus MIE 201
Typically offered in Spring only

MIE 410 Business Opportunity Analysis (3 credit hours)
Issues and management processes related to the identification of new business opportunities with emphasis on commercializing new technologies. Students will analyze and develop individual plans for commercialization of a new technology or other innovation. New venture formation is the primary focus, but the processes and skills students develop are relevant to new product introductions by existing firms.

Prerequisite: MIE 310
Typically offered in Fall, Spring, and Summer

MIE 411 Managing the Growth Venture (3 credit hours)
Managing a growth venture with emphasis on entrepreneurial planning in the dynamic context of rapidly growing ventures and the development of managerial skills necessary for successful leadership in high growth ventures. Fundamental concepts, issues and skills are taught through an integrated combination of readings, lectures, discussions, cases analyses, and applied project with a local venture. Students need to provide their own transportation to off-campus sites.

Prerequisite: MIE 310
Typically offered in Spring only

MIE 412 Finance and Accounting for Entrepreneurs (3 credit hours)
Financial planning for new ventures including financial reporting conventions and projection of critical financial amounts for new ventures. Introduction to fundamental accounting and finance concepts applied in the context of entrepreneurial ventures. Topics include projection of revenues, expenses, capital expenditures, cash flows, and balance sheet amounts; and the creation of pro-forma financial statements. Individual student projects integrate financial projections and pro-forma financial statements with the preparation of a complete business plan. Some individual off-campus travel is required.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 413 New Venture Planning (3 credit hours)
Developing the business plan for a new venture and the entrepreneurial process of executing the first phases of new venture creation. Topics include idea conception, entrepreneurship, business planning, market research, entrepreneurial opportunitiesand strategies. Emphasis is placed on high growth business opportunities. The final deliverable is a complete business plan for a high growth venture and formal presentation of the plan to mock investors. Some individual off-campus travel is required.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 416 The Legal Dynamics of Entrepreneurship (3 credit hours)
Overview of important legal and regulatory issues facing entrepreneurs and start-up entities including legal structure of the organization, intellectual property protection, human resource requirements, product liability, and risk management.

Prerequisite: MIE 310
Typically offered in Spring only

MIE 418 Social Entrepreneurship Practicum (3 credit hours)
Application of entrepreneurship skills and knowledge to plan a social entrepreneurial venture envisioned by the student. This course is a capstone course for the Minor in Entrepreneurship and the Concentration in Entrepreneurship. The deliverablesinclude an evaluation of the venture and a formal presentation including a summary of work completed and the implications of the work for each student's project. Students need to provide their own transportation to off-campus sites.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 419 Entrepreneurship Practicum (3 credit hours)
Application of entrepreneurship skills and knowledge to plan an entrepreneurial venture envisioned by the student. This course is the capstone course for the Minor in Entrepreneurship. The final deliverable includes an evaluation of the project and a formal presentation that includes a summary of the work completed and the implications of that work each student's project. Some individual off-campus travel is required.

Prerequisite: MIE 410
Typically offered in Fall and Spring

MIE 430 Teamwork in Organizations (3 credit hours)
This course will impart cutting edge thinking on leading in team-based organizations including the organizational changes required to move to a team-based structure and the organizational factors required to create successful work teams.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 432 Labor and Employee Relations (3 credit hours)
Utilizing textbook, readings, lectures, and practitioner presentations, students will become familiar with Employee Relations. Concepts in maintaining positive employer-employee relationships to promote productivity, morale, motivation and engagement will be reviewed. The course will explore the history of labor unions and the regulations that impact present day domestic and international business. The course will review approaches to negotiations.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 434 Compensation Systems (3 credit hours)
Compensation philosophy, strategy, and policy. Earnings, individual and group incentive plans, voluntary and mandated benefits. Legal, regulatory, economic, and strategic issues affecting compensation and benefits. Strategies for developing the structure and level of compensation to enhance organizational performance.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 435 Leadership and Management (3 credit hours)
Development of leadership and management skills for organizational settings. Self-awareness: interpersonal needs, attitudes toward change; cognitive styles, ethics and values; listening; communicating; interviewing; time and stress management; creativity and managing creativity. Team building and group dynamics. Leadership and followership: theory and case studies (Churchill, Antigone; Henry V; Machiavelli); the use of power and authority; women and leadership the use of language in leadership embodiment of leadership traits; effective traits and characteristics of great leaders.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 436 Training and Development (3 credit hours)
Training and development functions in organizations. Needs assessment, legal issues, training program design, learning, training methods, transfer of training, effectiveness and utility of training programs, and executive development.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 437 Human Resources Analytics (3 credit hours)
This course is an introduction to common analytical approaches used in human resource management. Various methods and analyses are helpful for HR professionals to evaluate questions and issues. Students in this course will learn statistical techniques that are often used to interpret organizational situations and information decision making. At the end of the course, students will be able to (a) develop and test research questions relevant for the organizational context; (b) critically evaluate quantitative information and illustrations you encounter; (c) communicate your understanding of statistics to others; and (d) perform common statistical analysis in Microsoft Excel, SAS, and/or R.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 438 Staffing (3 credit hours)
Staffing of contemporary organizations including strategic and environmental influences on: HR planning, job analysis, measurement, recruitment, assessment and selection, decision making, employment, and termination. Considerable emphasis on employment and labor recruitment, assessment and selection, decision making, employment, and termination. Considerable emphasis on employment and labor legislation.

Prerequisite: MIE 330
Typically offered in Fall and Spring

MIE 439 Human Resources Practicum (3 credit hours)
Utilizing textbooks, readings, lectures, and practitioner presentations, and an extended study of an organization's Human Resources practice and identified problem area, students will gain practical experience with diagnosing needs and then planning and recommending interventions to address identified needs. Experience with identifying needs will occur through needs assessment interviews with company representatives and analysis and interpretation of key demographic and relevant operational and HR metric data. Student groups need to provide their own transportation to off-campus sites.

Prerequisite: MIE 330
Typically offered in Spring only

MIE 480 Business Policy and Strategy (3 credit hours)
Comprehensive analysis of administrative policy-making from the point of view of the general manager. Integration of perspectives from marketing, finance, and other functional areas of management. Use of case analyses and written reports to develop decision making skills.

Corequisites: MIE 305, MIE 330, BUS 320, BUS 340, BUS 360, BUS 370, and (BUS/ST 350 or ST 305 or ST 312 or ST 370 or ST 372), and (ENG 331 or ENG 332 or ENG 333)
Typically offered in Fall, Spring, and Summer

MIE 495 Special Topics in MIE (1-6 credit hours)
Presentation of material normally not available in regular course offerings, or offering of new courses on a trial basis.

MIE 498 Independent Study in MIE (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction on a tutorial basis. Credits and content determined by faculty member in consultation with Department Head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Management (M)

M 100 Personal and Professional Identity Development (1 credit hours)
Personal and Professional Identity Development is a one-hour Poole required course which will help you learn about and develop multiple facets of your social and cultural identity, your strengths, and about how these things interrelate with leadership and career choices. By exploring the diverse components of your personal identity, you will have a better understanding of how you relate to and interact with others in a global business market. Through this course, you will learn about yourself, others and how you can use your strengths and your identity to create an action plan for future success at NC State, become engaged in your local community and engage in career path exploration.

R: Poole College of Management Students Only
GEP U.S. Diversity
Typically offered in Fall and Spring

M 120 Professional Development and Career Planning (1 credit hours)
The Professional Development Course is a one-credit hour course designed to give you the tools necessary to start your career. The course involves thoughtful self-assessment, career exploration, planning and follow-through with preliminary employment strategies. Taking advantage of the opportunities in this course will aid you in your transition from college student to intern to professional employee. The course navigates you through a more direct route to your long-term career goals by anticipating and acquiring the essential skill sets and experiences for an internship or entry-level job that will be the best starting point for your career.

R: Poole College of Management Students Only
Typically offered in Fall and Spring

M 298 Special Topics in Management (1-6 credit hours)
Presentation of material normally not available in regular course offering.

Typically offered in Fall, Spring, and Summer

M 299 Professional Internship in Management (1 credit hours)
Poole College of Management students participating in an approved internship with an organization providing no monetary compensation and where academic credit is required will have an opportunity to gain real world insight and experience into the day-to-day functions and responsibilities encountered in the professional workplace. Course may be completed only once for credit. Accounting majors completing M 299 and ACC 499 may receive a maximum of 6 credit hours for both courses. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Management Students Only
Typically offered in Fall, Spring, and Summer

M 300 Leadership and Professional Development (1 credit hours)
This course is specifically designed for new Peer Leaders and Ambassadors in the Poole College of Management. The goal of the course is to give students the necessary skills to become effective leaders and representatives both within and outside of the College. As a part of this course, students will attend Poole College of Management events/activities. Some topics we will discuss are: professional networking, communication, leadership, working in groups, and presentation skills.

Typically offered in Fall only

M 380 Doing Business Globally (3 credit hours)
International academic and cultural immersion into how business is conducted in a specific country/region abroad. Interdisciplinary exploration of political, and economic factors as they impact global business practices. Focus on key macro-environmental influences within a specific country/region as contrasted to those in the United States.

Restricted to: Study Abroad Students Only
GEP Interdisciplinary Perspectives
Typically offered in Summer only

M 399 International Business Dual Degree Student Professional Internship in Management (1-6 credit hours)
International Business Dual Degree students participating in an approved internship with an organization will have an opportunity to gain real world insight and experience into the day-to-day functions and responsibilities encountered in the professional workplace. Individualized/Independent Study and Research courses require that a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department. This course can be repeated with departmental consent and count towards a degree for students in the IBDD Program.

R: Poole College of Management major enrolled in the International Business Dual Degree Program
Typically offered in Fall, Spring, and Summer

Marine, Earth, and Atmospheric Sciences (MEA)

MEA 100 Earth System Science: Exploring the Connections (4 credit hours)
An introduction to the processes of and linkages among major components of planet Earth. Geosphere, hydrosphere, atmosphere, biosphere as dynamic and interdependent systems. Influence of human activity on earth systems. Optional weekend field trip.

Prerequisite: Competence in high school algebra and chemistry
GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 101 Geology I: Physical (3 credit hours)
Systematic consideration of processes operating on and below the earth's surface and the resulting features of landscape, earth structures, and earth materials. Occurrences and utilization of the earth's physical resources.

Corequisite: Recommended that MEA 110 be taken concurrently
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 110 Geology I Laboratory (1 credit hours)
Scientific methodology applied to the study of common rock-forming minerals, common rocks, topographic maps, geologic structures and geological maps. Field trips.

Corequisite: MEA 101 or Prerequisite: MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 130 Introduction to Weather and Climate (3 credit hours)
Explores the structure, physical causes, and climatology of weather systems including the jet streams, mid-latitude cyclones, hurricanes, thunderstorms, and tornadoes. Clouds and precipitation, air pollution, climate modification, optical effects (rainbows, halos) and weather instruments. Weather systems and forecasting techniques are illustrated through daily weather map discussions.

Prerequisite: For Non-Majors
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 135 Introduction to Weather and Climate Laboratory (1 credit hours)
Experiments include effects of air pressure change on temperature and density (gas law); measurement of atmospheric moisture; formation of clouds and hail; effects of variable solar heating. Graphical display and interpretation of data; weather instruments and observations; weather map analysis; forecasting principles.

Corequisite: MEA 130
GEP Natural Sciences
Typically offered in Fall and Spring

MEA 150 Environmental Issues in Water Resources (4 credit hours)
The science of current environmental concerns, particularly those related to water resources. Major topics include weather and climate, natural resource cycles, resource depletion and contamination, societal impacts. Scientific aspects of environmental issues. Required field trips.

GEP Natural Sciences
Typically offered in Fall only

MEA 200 Introduction to Oceanography (3 credit hours)
The ocean as a part of our environment including interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.

Corequisite: Recommended that MEA 210 be taken concurrently.
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 202 Geology II: Historical (3 credit hours)
The second semester of the basic introductory sequence in geology. Utilization of the principles of geology to reconstruct and understand the earth's history. Geologic events that cause modification of the earth's crust, emphasizing North America. History of life and the environmental significance of changes in animal and plant life through geologic time.

Prerequisite: (MEA 100, MEA 101, MEA 120, MEA 140 or MEA 200)and MEA 110; Corequisite: Recommended that MEA 211 be taken concurrently
GEP Natural Sciences
Typically offered in Spring only

MEA 210 Oceanography Lab (1 credit hours)
Complements the lecture course in Oceanography. Numerous demonstrations and resource materials visualize basic oceanographic concepts such as geological processes operating in the marine realm, the chemical properties of seawater, oceanic circulation, tides and waves, as well as processes affecting the biology of the oceans.

Corequisite: MEA 200
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MEA 211 Geology II Laboratory (1 credit hours)
Reconstruction and interpretation of events in the history of the earth. Interpretation of sedimentary rocks, construction and interpretation of geological maps, identification of fossil organisms and utilization of fossils in the reconstruction of earth history.

Corequisite: MEA 202
GEP Natural Sciences
Typically offered in Spring only

MEA 215 Introduction to Atmospheric Sciences (4 credit hours)
Introduction to the Earth's atmosphere. Fundamental concepts and applications of meteorology and how they relate to daily and seasonal weather, major types of storms, and climate.

Corequisite: MA 141
Typically offered in Spring only

MEA 217 Introduction to Computing in the Geosciences (3 credit hours)
This course is for students with little or no programming experience. It provides students with programming and problem solving skills using MATLAB with emphasis on the systematic development of algorithms and programs. Topics include Boolean math, data representation and types (array, vectors, strings, structures), evaluation of expressions, program control (iteration, functions), algorithm development (pseudo code, physical problem solving, numerical algorithms), basic MATLAB graphics, and limits of computing. Problems and projects are selected from the Geosciences. Students are expected to be proficient in solving algebraic equations, solving non-calculus Physics problems, including dimensional analysis, and operating a computer.

Typically offered in Fall only

MEA 220 Marine Biology (3 credit hours)
Introduction to marine plants and animals, their adaptations to life in the sea and ecological interactions in selected marine environments (e.g. coral reefs, deep sea, salt marshes). Interactions of man with the sea: food from the seas, biology of diving. Optional trip.

Prerequisite: MEA 200 or BIO 181
GEP Natural Sciences
Typically offered in Fall only

MEA 240 The Planets of Our Solar System (3 credit hours)
This course will cover the formation mechanisms, physical properties, and processes of the vast array of bodies that compose our Solar System, and how they compare and contrast with our own world. Among the diverse range of topics we will explore are planetary formation, volcanism of Mars, the deep oceans of Jupiter's icy moons, the atmosphere of Venus, and the fate of our Sun. We will also focus on what other planetary bodies can tell us of the early and future Earth, as well as the conditions required for planetary habitability. Finally, we will consider the exciting field of exoplanet research, including the search for extraterrestrial intelligence, and discuss key milestones in the exploration of the Solar System. Delivered through lectures, in-class discussion, and associated reading, the course will be assessed through a series of quizzes, an essay, a group project, and two mid-term exams and a final exam.

GEP Natural Sciences
Typically offered in Fall only

MEA 250 Introduction to Coastal Environments (3 credit hours)
A global survey of coastal habitats, the processes that shape these dynamic environments, and the physicochemical controls that regulate their indigenous biological communities.

Prerequisite: MEA 200/210 or MEA 101/110
GEP Natural Sciences
Typically offered in Spring only

MEA 251 Introduction to Coastal Environments Laboratory (1 credit hours)
Complements the lecture course Introduction to Coastal Environments (MEA 250). Experiments involving the physical, chemical and biological processes that shape a variety of coastal environments.

Corequisite: MEA 250
Typically offered in Spring only

MEA 252 Biology of Marine Mammals (3 credit hours)
Biology of marine mammals, including cetaceans, pinnipeds, sirenians and sea otters. Topics covered include the evolution, physiology, behavior and ecology of marine mammals. We will focus on current topics in conservation and management of marine mammals. Instructor permission required.

Typically offered in Spring only

MEA 257 Visualizing Geology in 3D & 4D (1 credit hours)
MEA 257 will provide students with a strong foundation of essential spatial visualization skills needed to successfully complete courses in the geology curriculum. Students will be guided to complete activities that require them to create and interpret a variety of geological visualizations including maps, cross-sections, physical models, three-dimensional figures, and Google Earth images.

P: MEA 110 and either MEA 101 or MEA 100
Typically offered in Spring only

MEA 260 Human Dimensions of Climate Change (3 credit hours)
Climate is changing with potentially catastrophic implications for the Earth and for people. In this course we discuss how and why climate is changing and how climate change is affecting and will affect human well-being in society. We draw upon the multiple disciplinary lenses and diverse perspectives needed to evaluate, across multiple dimensions, proposed solutions to climate change and/or to assess fully the consequences of inaction.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

MEA 300 Environmental Geology (4 credit hours)
Geologic aspects of the environment. Effects of humans upon or interactions with geologic processes. Geologic considerations in land use planning, waste disposal, water resources, and natural resources. A field and lab oriented course with combined lecture/laboratory. Inquiry-based learning approach to study the basic processes of environmental geology and develop research skills. Required field trips.

Prerequisite: MEA 101 or MEA 150 or MEA 140 or SSC 200
Typically offered in Spring only

MEA 312 Atmospheric Thermodynamics (4 credit hours)
Introduction to atmospheric thermodynamics for meteorology majors. Topics include the equation of state for mixture of gases; first and second laws of thermodynamics; diabatic and adiabatic processes for dry and moist air; measurement and phase changes of water vapor. Atmospheric statics: static stability of moist air; CAPE and vertical acceleration. Focus will be on applying the rigorous framework of classical thermodynamics to derive and solve quantitatively the governing equations describing these processes.

Prerequisite: MA 141, PY 205; Corequisite: MA 241
Typically offered in Spring only

MEA 315/MA 315 Mathematics Methods in Atmospheric Sciences (4 credit hours)
For sophomore meteorology and marine science students. A complement to MA 242 designed to prepare students for quantitative atmospheric applications. Topics include an introduction to vectors and vector calculus, atmospheric waves, phase and group velocity, perturbation analysis, fourier decomposition, matrix operations, chaos and predictability. For MY, MMY, and MRM majors only.

Prerequisite: MEA 217 or MA 116 or CSC 113; Corequisite: MA 242
Typically offered in Spring only

MEA 320/ET 320 Fundamentals of Air Pollution (3 credit hours)
Students will learn fundamental concepts in air pollution and the application of those concepts for compliance with air quality regulations. Topics include air pollutants, their properties, how they are emitted, and relevant atmospheric chemistry and physics processes, National Ambient Air Quality Standards (NAAQS) and how compliance with those regulations is maintained.

Prerequisite: MA 121 or MA 131 or MA 141, CH 101/102, PY 131 or PY 201 or PY 205 or PY 211; Recommended: CH 220/222 or CH 221/222
Typically offered in Spring only

MEA 321 Fundamentals of Air Quality and Climate Change (3 credit hours)
An intermediate-level introduction, for meteorology majors, to the physical and chemical environment of the atmosphere and to climate change. Topics include the atmosphere's chemical composition; atmospheric chemical reaction processes in gas phase, liquid phase, and on particle surfaces

Prerequisite: Two semesters of chemistry (CH 101 and {CH 201, CH 220, or CH 221}), MA 141, MA 241; Corequisite: PY 205
Typically offered in Fall only

MEA 323 Geochemistry of Natural Waters (3 credit hours)
Biogeochemical processes related to water in the natural environment. Course focuses on chemical equilbria and kinetics of: precipitation and dissolution, acid-base chemistry and the carbonate system, oxidation-reduction chemistry, and organic geochemistry in lakes, rivers, estuaries, and oceans. Topics revolve around water quality and global change. Course includes in class field sampling and lab work as well as a mandatory Saturday field trip.

Restriction: MEA and ENE Majors Only. Other Majors With Permission of Instructor; Prerequisite: CH 201 or CH 203
Typically offered in Fall and Spring

MEA 350 Marine Conservation Biology (3 credit hours)
This course will focus on the field of marine conservation, including the scientific, regulatory, social and economic factors that must be considered when trying to solve complex conservation issues. Important concepts will include: (i) sampling and experimental design, (ii) modern definitions of conservation, scientific areas of expertise in conservation, (iii) priority threats to biodiversity, (iv) laws which govern conservation in the US and internationally, and (v) social and economic considerations. The class will include presentation and critical evaluation of global, regional and local case studies marine conservation actions. Optional Friday field trips. Instructor permission required.

Typically offered in Spring only

MEA 369 Life on Earth: Principles of Paleontology (3 credit hours)
This class offers an interdisciplinary introduction to the history of life on Earth and the principles of paleontology that allow for its study and application. Key topics include: fossil records and description, evolution and extinction, paleoecology and biostratigraphy, field/lab methods, and a survey of major life forms from the early Earth through the present. This course is a learning-centered program aimed at students interested in past life and using paleontology as a tool for examining the natural world. Required field trips.

P: BIO 181 or MEA 202
Typically offered in Spring only

MEA 409 Watershed Forensics (3 credit hours)
Spatial analysis of watersheds with emphasis on pollution and controversies concerning water quality and regulation issues. GIS exercises will introduce students to the latest spatial analytical techniques. Case studies and lectures will be used to examine common watershed contaminates.

Prerequisite: GIS 280
Typically offered in Fall only

MEA 410 Introduction to Mineralogy (4 credit hours)
Introduction to the basics of Mineralogy (crystallography, morphology, crystallochemistry, optics, and systematics), with an emphasis on mineral identification both at the macro (hand sample) and micro (thin section) scale. Required field trip to the North Carolina Museum of Natural Sciences. Transportation is not provided.

Prerequisite: (MEA 100, MEA 101, or MEA 200), and MEA 110 and CH 101/102
Typically offered in Fall only

MEA 411 Marine Sediment Transport (3 credit hours)
Quantitative study of sediment transport in the marine environment including an introduction to fluid mechanics and sediment transport theory. Discussion of the processes and products of sediment transport in specific marine environments from estuaries to the deep sea and interpretation of sediment transport processes from sedimentary structures. Credit not allowed for both MEA 411 and MEA 562

Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205
Typically offered in Fall only

MEA 412 Atmospheric Physics (3 credit hours)
Physical and analytical descriptions of atmospheric aerosols, clouds/fogs, and precipitation processes; size distribution and sources of atmospheric aerosols; impact of aerosols on visibility and climate; microstructure of warm and cold clouds and their interaction with solar and terrestrial radiation; collision-coalescence and ice phase mechanisms of precipitation formation; atmospheric electricity; planned and inadvertent weather modification; weather radar; atmospheric optics.

Prerequisite: MA 242, PY 205
Typically offered in Spring only

MEA 415/MEA 515 Climate Dynamics (3 credit hours)
A comprehensive look at climate integrated across terrestrial, marine, and atmospheric perspectives. Topics include an in-depth look at climate proxies, drivers of future, current and past climate change, climate monitoring approaches, and climate model projections. Students will be exposed to the quantitative aspects (chemistry, physics, theory, observations, models) scientists use to place constraints on climate conditions over broad spatial and temporal scales. MEA 415 is open to upper-level undergraduate science majors interested in learning more about Earth's climate systems and the dynamics within. MEA 515 is open to all graduate students with the expectation of an additional climate assessment course project relevant to the student's own research discipline. Students cannot receive credit for both MEA 415 and MEA 515.

Prerequisite: MA 121 or MA 131 or MA 141 and CH 101 or CH 103 and PY 201 or PY 205 or PY 211
Typically offered in Fall only

MEA 421 Atmospheric Dynamics I (3 credit hours)
Meteorological applications of fluid kinematics: divergence, vorticity, deformation, advection, mass continuity and vertical motion. Atmospheric dynamics: the equation of motion on a rotating earth; component equations in Cartesian, polar-sphericaland pressure coordinates. Scale analysis and simplifications. Cases of horizontal flow: geostrophic and gradient wind, ageostrophy and acceleration; thermal wind and vorticity.

Prerequisite: MA 242 and PY 205 and MEA 312
Typically offered in Fall only

MEA 422 Atmospheric Dynamics II (3 credit hours)
Vorticity and potential vorticity equations; dynamics of synoptic-scale motions; quasi-geostrophic theory; atmospheric waves including shallow water, internal gravity, inertia-gravity, and Rossby waves; finite difference methods; numerical weather prediction; atmospheric instabilities including static, Kelvin-Helmholtz, inertial, symmetric, barotropic, and baroclinic instabilities.

Prerequisite: MEA 421
Typically offered in Spring only

MEA 425/MEA 525 Introduction to Atmospheric Chemistry (3 credit hours)
The course covers history, regulations, sources, physics, and chemistry of major air pollutants and factors affecting their transport and fate. Emphasis is placed on atmospheric chemistry and physics underlying five major air pollutant problems including urban outdoor air pollution, indoor air pollution, acid deposition, stratospheric ozone reduction, and global climate change. Credit will not be allowed for MEA 425 and MEA 525.

Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320)
Typically offered in Fall, Spring, and Summer

MEA 440 Igneous and Metamorphic Petrology (4 credit hours)
The study of rocks formed by the crystallization of magmas (igneous) and by the recrystallization of existing rocks (metamorphic), with emphasis on whole-rock and mineral compositions, classification, petrography, hand-sample and thin-section identification, and the rock origins in terms of magma genesis and emplacement and tectonics. Field trips are required.

Prerequisite: MEA 410
Typically offered in Spring only

MEA 443 Synoptic Weather Analysis and Forecasting (4 credit hours)
Analysis and forecasting of mid-latitude weather systems with emphasis on simplified models and methods. Barotropic model, Rossby waves; baroclinic structure, upper-level wave evolution, forecasting; surface cyclone evolution, Sutcliffe-Petterssen model. Numerical computation methods; numerical weather prediction and operational models, subjective and objective analysis of meteorological fields.

Prerequisite: MEA 421
Typically offered in Fall only

MEA 444 Mesoscale Analysis and Forecasting (4 credit hours)
Analysis and forecasting of mid-latitude weather systems with emphasis on mesoscale phenomena. Definition of the mesoscale, approximations to the governing equations, basic measurements and techniques; observations, basic governing dynamics, and forecasting of mesoscale phenomena, including drylines, low-level jets, conditional symmetric instability, crographically-induced circulations, thunderstorms, mesoscale convective, and severe convective weather.

Prerequisite: MEA 443
Typically offered in Spring only

MEA 449/MEA 549 Principles of Biological Oceanography (3 credit hours)
Environmental dependencies, biological productivity, and trophic relationships in plankton, nekton and benthos; Sampling methods and experimental design; Human impacts on marine systems.Credit is not allowed for both MEA 449 and MEA(ZO)549.

Typically offered in Fall only

MEA 450 Introductory Sedimentology and Stratigraphy (4 credit hours)
Properties and classification of sediments and sedimentary rocks, geologic occurrences and origin of minerals and rocks formed by physical, chemical, and biologic processes at and near the Earth's surface. Principles of the division of stratified terrains into natural units, the correlation of strata and associated data, the interpretation of depositional environments, facies, and sequences, description of burial histories, and sedimentary basin analysis. Required field trips.

Prerequisite: MEA 410
Typically offered in Spring only

MEA 451 Structural Geology (4 credit hours)
Basic principles of geometric, kinematic and dynamic analysis as applied to fractures, shear zones, folds, and fabrics of deformed rock bodies. Considers both brittle and ductile realms of the crust from microscale to regional tectonics. Required overnight field trips.

Prerequisite: MEA 410
Typically offered in Fall only

MEA 454/MEA 554 Marine Physical-Biological Interactions (3 credit hours)
Space-time relationships between physics and biology; influence of Reynolds Number on aquatic life style; aspects of physical and biological mathematical modeling; influence of biology on physical phenomena; influence of static physical/chemical properties on biology; influence of dynamic physical phenomena (turbulence, waves and advection) on biology within the water column and its boundaries. Credit is not allowed for both MEA454 and 554

Prerequisite: MEA 460 and MEA/ZO 449
Typically offered in Spring only

MEA 455 Micrometeorology (3 credit hours)
Energy budget near the earth's surface; soil temperatures and heat transfer; air temperature, humidity, and wind distribution in the planetary boundary layer; fundamentals of viscous flows and turbulence; semiempirical theories of turbulence; exchanges of momentum, heat and moisture in the atmospheric surface layer; air modification due to changes in surface properties; agricultural and forest micrometeorology.

Prerequisite: MEA 422 or MAE 308
Typically offered in Fall only

MEA 458 Introduction to Tropical Meteorology (3 credit hours)
Introduction to tropical meteorology using phenomenological examples. Thermodynamic structure of the mean tropical atmosphere, Hadley circulation, equatorial waves and the Madden Julian oscillation, El Nino-Southern oscillation, monsoons and tropical cyclones. Meteorology majors only. Meteorology majors only.

Prerequisite: MEA 422
Typically offered in Fall only

MEA 459 Field Investigation of Coastal Processes (5 credit hours)
Coastal zone processes and dynamics with emphasis on the forcing factors that regulate changing coastal landforms, the ecology and physicochemical character of coastal ocean water-masses, seabed morphologies, landscape academes, etc. Field observations and field techniques will be emphasized in tidal-freshwater coastal wetlands, estuaries, barrier island, tidal inlets, continental shelves and shelf-margin habitats. Additional fees required.

Prerequisite: MEA 250
Typically offered in Summer only

MEA 460 Principles of Physical Oceanography (3 credit hours)
Introduction to principles and practices of physical oceanography. Equation of state of seawater; energy transfer to the ocean by thermal, radiative and mechanical processes; the heat budget; oceanic density distribution; oceanic boundary conditions; conservations equation; air-sea interaction; global fluxes and general description of major ocean currents. Credit is not allowed for both MEA 460 and MEA 540

Prerequisite: MA 241 or MA 231; Corequisite: PY 203,PY 208 or PY 212.
Typically offered in Fall only

MEA 462 Observational Methods and Data Analysis in Marine Physics (3 credit hours)
Practical experience in the observational techniques used by physical oceanographers. Basic instrumentation described, emphasizing principles rather than detailed descriptions. Both direct and indirect techniques used to define the three-dimensionalcirculation of the ocean as a function of time.

Prerequisite: MEA 460
Typically offered in Spring only

MEA 463 Fluid Physics (3 credit hours)
A derivation of the basic equations governing fluid motion in a rotating coordinate system. Equations include conservation of mass or the continuity equation, momentum equations, thermodynamic energy equation and the vorticity equation. Application of equations to simplified oceanic flows which include surface gravity waves, inertial motion, geostrophic motion, Ekman dynamics and vorticity dynamics.

Prerequisite: MA 341 and PY 208
Typically offered in Fall only

MEA 464 Ocean Circulation Systems (3 credit hours)
Dynamical processes governing ocean circulation. Driving of ocean currents by the atmosphere, currents on a rotating spherical earth. Mid-ocean gyre, western boundary currents, equatorial current systems, and polar circulation. Currents in coastal regions and shallow-water processes.

Prerequisite: MEA 460
Typically offered in Spring only

MEA 465 Geologic Field Camp (4 credit hours)
Introduction to field instruments and techniques used in geological sciences. Geologic field mapping in areas ranging from undeformed sedimentary rocks to complexly deformed crystalline rocks. May include field techniques specific to engineering geology, geophysics, hydrogeology, and paleontology. Preparation of maps and reports. Four-week course taught off-campus, typically out-of-state. Additional fees required.

Prerequisite: MEA 450 and MEA 451
Typically offered in Summer only

MEA 466 Preparatory Course for Field Camp (1 credit hours)
Introduction to theory, instruments, and techniques used in MEA 465 geologic field camp. Geologic context of the area where field camp will be held. Students will supply their own graph paper for a map cross-section exercise. Credit for this course cannot be used to fulfill elective credits in any Geology curricula.

Typically offered in Spring only

MEA 467 Marine Meteorology (3 credit hours)
Basic equation and concepts. Review of ocean and atmospheric circulations. Ocean mixed layer, air-sea interaction and coastal ocean and meteorological processes, marine boundary layer and cloud processes.

Prerequisite: MA 241 and PY 205
Typically offered in Spring only

MEA 468/MEA 568 Aquatic Microbiology (3 credit hours)
Aquatic microbes are key drivers of biogeochemistry on Earth. They also influence the 'health' of valuable ecosystems, e.g. estuaries, coasts, lakes, as well as, larger organisms (e.g. shellfish, humans). In this course, multiple facets of aquatic microbiology will be covered, including (not limited to): population diversity, spatial and temporal dynamics, sampling methodologies, metabolisms, and their environmental and societal importance. A primary goal for this course is for students to be exposed to key paradigms and current challenges within the field of aquatic microbiology, but also a general perspective on how aquatic microbes thrive in nature. Although largely a classroom-based course, select class periods will be devoted to hands-on activities and/or measurements providing students with methodological experience or in-depth exposure to key topics.

Prerequisite: BIO 183
Typically offered in Fall only

MEA 469 Ecology of coastal Resources (3 credit hours)
Anthropogenic impacts on estuarine and coastal marine ecosystems. Survey of basic biological, physical, chemical and geological mechanisms underlying habitat-specific functioning, followed by discussion, in-class presentation, and critique of real and hypothetical case studies involving anthropogenic impacts.

Prerequisite: MEA 250 and MEA 220 or MEA 449
Typically offered in Spring only

MEA 470 Introduction to Geophysics (3 credit hours)
Structure of the earth, a dynamic and evolving entity, as inferred from seismology, gravity, magnetism and heat flow. Geodynamic processes responsible for continental drift; plate tectonic theory; regional geophysics of selected areas.

Prerequisite: PY 208 or 212

MEA 471 Exploration and Engineering Geophysics (3 credit hours)
Geophysical methods applied to exploring the earth's shallow sub-surface. Principles of gravity, magnetic, electrical, and seismic exploration surveys. Planning, conducting, and interpreting geophysical surveys.

Prerequisite: PY 208 or PY 211

MEA 473/MEA 573 Principles of Chemical Oceanography (3 credit hours)
Chemical processes controlling the composition of oceans, including discussions of chemical equilibria, biological cycling of nutrients and use of chemical tracers in marine environment; consideration of origin and chemical history of oceans. Creditis not allowed for both MEA 473 and MEA 573

Prerequisite: CH 201 or CH 203
Typically offered in Fall only

MEA 476 Worldwide River and Delta Systems: Their Evolution and Human Impacts (3 credit hours)
Survey of major world rivers and deltas, such as the Amazon, Mississippi, Yello, Yangtze, Mekong, Ganges-Brahmaputra, Indus, Nile, etc. Descriptions of their initiation, development, and evolution processes. Definitions of the impacts caused by climate changes and human activities. Examination of the river-ocean interactions and sedimentary and geochemical processes in terms of sea-level change, monsoon, and sediment dispersal and deposition.

Prerequisite:Senior undergraduate or Graduate standing
Typically offered in Fall only

MEA 479/CE 479 Air Quality (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the "acid rain: problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE/MEA 479 or CE/MEA 579.

CE 282 and CE 373; or CHE 311(CHE Majors); or MEA 421 (MEA Majors); Corequisite: ST 370; or ST 380 (MEA Majors)
Typically offered in Spring only

MEA 481 Geomorphology: Earth's Dynamic Surface (3 credit hours)
Landforms and the processes responsible for their origin. Emphasis on the geologic principles involved in interpreting the origin and evolution of various landforms, and discussion of North American geomorphic process.

Prerequisite: (MEA 100 or MEA 101 or MEA 200) and MEA 110
Typically offered in Spring only

MEA 485 Introduction to Hydrogeology (3 credit hours)
Basic science of groundwater flow in geological media. Saturated and unsaturated flow, Darcy's equation, heterogeneity and anisotrophy, flownets, storage properties of geological materials, effective stress, equations for steady and unsteady flow, recharge, groundwater exchange with surface water, groundwater flow to pumping wells, estimation of hydraulic properties of aquifers, contaminant plumes and chemical transport in groundwater.

Prerequisite: (MEA 101 or MEA 202), (MA 131 or MA 141), (CH 201 or CH 203), and (PY 201, PY 205, or PY 211)
Typically offered in Fall only

MEA 488 Meteorology for Media (3 credit hours)
Communication of weather and climate information with the public, including examination of communication theory, public communication of science, and geoscience communication research. Production techniques for television and digital graphics, presentation to camera, and audio recordings.

Prerequisite: One of the following ENG 331, ENG 332, ENG 333, or COM 110
Typically offered in Fall only

MEA 493 Special Topics in MEAS (1-6 credit hours)
Directed individual study or experimental course offering.

Typically offered in Fall, Spring, and Summer

MEA 495 Junior Seminar in the Marine, Earth, and Atmospheric Sciences (1 credit hours)
Emphasis on student professional development. Discussions of professional opportunities, resources, and ethics. Professionals from the public and private sectors introduce students to career options in marine, earth and atmospheric sciences. Strategies for finding jobs and graduate programs. Students reflect on future career goals and plans. For MEAS majors only.

R: MEAS Majors Only
Typically offered in Spring only

MEA 498 Internship in MEAS (1-6 credit hours)
Awards academic credit for learning that occurs during internships. Requires daily journal and written summary report. Successful completion of the course based on review of summary report by an MEAS faculty, who shall be identified by the studentprior to the internship. Transportation expenses may be incurred. MEAS majors only. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

MEA 507 Discipline-based Education Research in the Geosciences (3 credit hours)
This course will prepare students to explain the conditions necessary for learning to occur in college geoscience classes; plan lessons that address geoscience literacy standards and incorporate activities that feature multiple levels of Bloom's taxonomy; describe how they would determine if student work meets defined learning goals; create effective geoscience learning environments for lecture and lab settings; analyze the teaching of others using validated instruments; and design a geoscience teaching and learning research project.

Typically offered in Spring only

MEA 510 Air Pollution Meteorology (3 credit hours)
Wind structure in atmospheric surface layer and planetary boundary layer; temperature structure and stability; mixed layer and inversions; turbulence intensity and scale; meteorological factors affecting dispersion of pollutants; diffusion theories and models; diffusion and transport experiments; plume rise, fumigation and trapping; removal processes; effects of buildings and hills; effects of local winds.

Prerequisite: MAE 308 or MEA 455 or MEA 700
Typically offered in Spring only

MEA 511 Introduction to Meteorological Remote Sensing (3 credit hours)
Meteorological remote sensing data sets used in operational forecast and research applications. Sensor physical principles. Emphasis is on understanding the strengths and weaknesses of the different types of observational data so that the student can judge adequacy of purpose for their applications.

Typically offered in Fall only

MEA 514 Advanced Physical Meteorology (3 credit hours)
Fundamental laws and concepts of thermodynamics and electromagnetic radiative transfer considered in an atmospheric context. Application of these principles to a number of meteorological problems, including radiative climate models, the global energy balance, atmospheric aerosols, lidar/radar backscatter and remotely sensed temperature fields.

Prerequisite: MEA 412, MEA 421
Typically offered in Fall only

MEA 515/MEA 415 Climate Dynamics (3 credit hours)
A comprehensive look at climate integrated across terrestrial, marine, and atmospheric perspectives. Topics include an in-depth look at climate proxies, drivers of future, current and past climate change, climate monitoring approaches, and climate model projections. Students will be exposed to the quantitative aspects (chemistry, physics, theory, observations, models) scientists use to place constraints on climate conditions over broad spatial and temporal scales. MEA 415 is open to upper-level undergraduate science majors interested in learning more about Earth's climate systems and the dynamics within. MEA 515 is open to all graduate students with the expectation of an additional climate assessment course project relevant to the student's own research discipline. Students cannot receive credit for both MEA 415 and MEA 515.

Prerequisite: MA 121 or MA 131 or MA 141 and CH 101 or CH 103 and PY 201 or PY 205 or PY 211
Typically offered in Fall only

MEA 516 Climate Risk Analysis (3 credit hours)
Prepares students to analyze climate data for decision making under uncertainties in climate conditions and projections. Diverse observational and model generated climate data sets are considered. For observed data, the assumptions and statistical methods used to assess trends are explored and critically analyzed. Subsequent course work focuses on spatial analyses of climate-related anomalies and trends and on ensemble predictions, including their application to climate sensitive systems. Students become proficient in the visualization of climate information. This course requires permission from the instructor to join.

Prerequisites: MEA 517 (or equivalent), ST 305 (or equivalent) or MA 141 (or equivalent)
Typically offered in Spring only

MEA 517 Fundamentals of Climate Change Science (3 credit hours)
This course will present the basic science of climate change, including chemical and physical systems and processes. The students will be introduced to how the climate system works and the role of greenhouse gases in the climate system. Students will learn about climatological data, climate models and how predictions/projections are made. Emphasis will be placed upon relating predicted/projected changes to manifestations such as sea level rise and changes in the distribution and character of precipitation. Topics include the primary climate components, ocean-atmospheric teleconnections, decadal and multi-decadal climate indices, natural and anthropogenic climate variability, and climate model projections.

Prerequisite: Graduate standing
Typically offered in Fall only

MEA 518 Adaptation to Climate Change (3 credit hours)
Climate Adaptation investigates the technological, economic, communication, scientific and legal challenges inherent to adaptation to climate change. This course provides practical hands-on experience for professionals in developing adaptation strategies in climate sensitive sectors. Content draws heavily on case studies in international development, infrastructure, health, energy, and transportation sectors.

Prerequisites: MEA 517 or permission from instructor
Typically offered in Spring only

MEA 519 Barriers to Climate Change Literacy (3 credit hours)
Investigates the discipline-based geoscience education lenses of the cognitive, affective, and behavioral barriers to climate literacy and the practical interventions for addressing them. Critically analyzes key aspects of climate science, common misconceptions, mental models, cultural influences, and risk perceptions about climate change. Students engage with the public and design projects for overcoming barriers to climate change literacy. The course features relevant readings, classroom discussions, student peer-review, and summative and formative course feedback though course assignments and exams. Minimum of 50% seats reserved for Climate Change and Society Certificate program students.

Prerequisite: Graduate standing
Typically offered in Fall only

MEA 525/MEA 425 Introduction to Atmospheric Chemistry (3 credit hours)
The course covers history, regulations, sources, physics, and chemistry of major air pollutants and factors affecting their transport and fate. Emphasis is placed on atmospheric chemistry and physics underlying five major air pollutant problems including urban outdoor air pollution, indoor air pollution, acid deposition, stratospheric ozone reduction, and global climate change. Credit will not be allowed for MEA 425 and MEA 525.

Prerequisite: MA 141, CH 201, (PY 205, PY 211 or MEA 320)
Typically offered in Spring only

MEA 540 Principles of Physical Oceanography (3 credit hours)
Introduction to principles and practice of physical oceanography. The equation of state of seawater; energy transfer to the ocean by thermal, radiative and mechanical processes; the heat budget; oceanic boundary conditions; geographical distributionof oceanic properties; observational methods; conservation equations; simple waves and tides; physical oceanography of North Carolina coastal zone. Application of Fourier analysis techniques to interpretation of low-frequency motions in ocean and atmosphere. Review of Fourier method. Filtering of tidal signals. Spectral estimates and calculation of current ellipses. Identification of coherent motions and their empirical orthogonal modes. Data from field experiments used in lectures and homeworkassignments. Credit is not allowed for both MEA 460 and MEA 540

Prerequisite: MA 231 and PY 212
Typically offered in Spring only

MEA 549/MEA 449 Principles of Biological Oceanography (3 credit hours)
Environmental dependencies, biological productivity, and trophic relationships in plankton, nekton and benthos; Sampling methods and experimental design; Human impacts on marine systems.Credit is not allowed for both MEA 449 and MEA(ZO)549.

Typically offered in Fall only

MEA 553 Estuarine Biogeochemistry (3 credit hours)
Biogeochemical cycles of carbon, nitrogen, and phosphorus in coastal rivers and estuaries with selected topics on the origin, physics, and chemistry of estuarine waters and sediments. Emphasis is placed on organic matter and nutrient cycling in estuaries within the context of anthropogenic effects and climate change.

Typically offered in Spring only

MEA 554/MEA 454 Marine Physical-Biological Interactions (3 credit hours)
Space-time relationships between physics and biology; influence of Reynolds Number on aquatic life style; aspects of physical and biological mathematical modeling; influence of biology on physical phenomena; influence of static physical/chemical properties on biology; influence of dynamic physical phenomena (turbulence, waves and advection) on biology within the water column and its boundaries. Credit is not allowed for both MEA454 and 554

Prerequisite: MEA 460 and MEA/ZO 449
Typically offered in Spring only

MEA 562 Marine Sediment Transport (3 credit hours)
Quantitative study of sediment transportation in the marine environment including introduction to fluid mechanics and sediment transportation theory. Processes and products of sediment transportation in specific marine environments from estuaries todeep sea and the interpretation of sediment transport processes from sedimentary structures. Credit not allowed for both MEA 411 and MEA 562

Prerequisite: MEA 101 or MEA 200, MA 241, PY 201 or PY 205
Typically offered in Fall only

MEA 568/MEA 468 Aquatic Microbiology (3 credit hours)
Aquatic microbes are key drivers of biogeochemistry on Earth. They also influence the 'health' of valuable ecosystems, e.g. estuaries, coasts, lakes, as well as, larger organisms (e.g. shellfish, humans). In this course, multiple facets of aquatic microbiology will be covered, including (not limited to): population diversity, spatial and temporal dynamics, sampling methodologies, metabolisms, and their environmental and societal importance. A primary goal for this course is for students to be exposed to key paradigms and current challenges within the field of aquatic microbiology, but also a general perspective on how aquatic microbes thrive in nature. Although largely a classroom-based course, select class periods will be devoted to hands-on activities and/or measurements providing students with methodological experience or in-depth exposure to key topics.

Prerequisite: BIO 183
Typically offered in Fall only

MEA 570 Geological Oceanography (3 credit hours)
A comprehensive overview of the geological aspects of oceanography. Topics include: a) marine geophysics and the evolution of ocean basins, b) sedimentological processes and the formation of marine deposits, c) marine geochemistry and authigenic sedimentation, d) paleoceanography and the interpretation of marine stratigraphy.

Typically offered in Spring only

MEA 573/MEA 473 Principles of Chemical Oceanography (3 credit hours)
Chemical processes controlling the composition of oceans, including discussions of chemical equilibria, biological cycling of nutrients and use of chemical tracers in marine environment; consideration of origin and chemical history of oceans. Creditis not allowed for both MEA 473 and MEA 573

Prerequisite: CH 201 or CH 203
Typically offered in Fall only

MEA 574 Advanced Igneous Petrology (3 credit hours)
Physicochemical principles related to igneous petrogenesis. General principles and specific problems including origin, differentiation and emplacement of magmas and the possible relationships of igneous processes to global tectonics.

Prerequisite: MEA 440
Typically offered in Spring only

MEA 577 Electron Microprobe Analysis of Geologic Material (2 credit hours)
Theory of quantitative analysis of geologic material by electron beam application; laboratory operation of electron microprobe to acquire chemical composition and x-ray images of geologic material.

Prerequisite: MEA 410
Typically offered in Fall only

MEA 579 Principles of Air Quality Engineering (3 credit hours)
Introduction to: risk assessment, health effects, and regulation of air pollutants; air pollution statistics; estimation of emissions; air quality meteorology; dispersion modeling for non-reactive pollutants; chemistry and models for tropospheric ozone formation; aqueous-phase chemistry, including the "acid rain" problem; integrated assessment of air quality problems; and the fundamentals and practical aspects of commonly used air quality models. Credit is allowed only for one of CE/MEA 479 or CE/MEA 579

Prerequisite: CE 373,CE 282; or CHE 311(CHE Majors); or MEA 421(MEA Majors), Corequisite: ST 370; ST 380(MEA Majors)
Typically offered in Spring only

MEA 580 Air Quality Modeling and Forecasting (4 credit hours)
Topics include numerical solutions to ODEs/PDEs, atmospheric chemistry, cloud and aerosol microphysics, emission modeling, meteorological modeling, and model design, applications, and evaluation. It is targeted for students who would like to learn about air quality modeling and who are prospective air quality model users.

Prerequisite: CSC 112, MEA 425/525, CE 479/579
Typically offered in Fall and Spring

MEA 581/CE 581 Fluid Mechanics in Natural Environments (3 credit hours)
Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Review of fundamental principles of fluids, covering the scales relevant to both engineering and geo-physical applications. Topics and examples include waves, instability, stratification, turbulent boundary layers, jets and plumes, and open channel flows. Cannot receive credit for both CE 581 and MEA 581.

Prerequisite: CE 282 or MEA 463 or permission of instructor
Typically offered in Fall only

MEA 582/GIS 582 Geospatial Modeling (3 credit hours)
The course provides foundations in methods for GIS-based surface analysis and modeling. The topics include proximity analysis with cost surfaces and least cost paths, multivariate spatial interpolation and 3D surface visualization. Special focus is on terrain modeling, geomorphometry, solar irradiation, visibility, and watershed analysis. Students are also introduced to the basic concepts of landscape process modeling with GIS and to the principles of open source GIS. Introductory level knowledge of GIS or surveying/ geomatics principles is required.

Typically offered in Fall and Spring

MEA 584/GIS 584 Mapping and Analysis Using UAS (3 credit hours)
The course provides an overview of UAS mapping technology and its rules and regulations. The principles of UAS data collection are explained along with optional hands-on practice with in flight planning and execution. The main focus is on processing imagery collected from UAS using structure from motion techniques and deriving orthophoto mosaics and ultra-high resolution digital elevation models of land surface, vegetation and structures. More advanced topics include multi-temporal 3D data analysis, fusion with lidar data and 3D visualization.

Prerequisite: GIS 510 or GIS/MEA 582 or Permission of Instructor
Typically offered in Summer only

MEA 585 Physical Hydrogeology (3 credit hours)
Physical aspects of groundwater flow in geological media. Saturated and unsaturated flow, Darcy's equation, heterogeneity and anisotropy, storage properties of geological materials, effective stress, governing equations for steady and unsteady flow, recharge, groundwater exchange with surface water, groundwater flow to well,s estimation of hydraulic properties of aquifers.

Prerequisite: MEA 101, MEA 110, MA 241, and PY 201 or PY 205
Typically offered in Spring only

MEA 591 Special Topics in Marine Science (1-6 credit hours)
Opportunity for advanced undergraduate and graduate students to study timely special problem areas in Marine Science and Engineering

Typically offered in Fall, Spring, and Summer

MEA 592 Special Topics in Earth Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 593 Special Topics in Atmospheric Science (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 599 Regional Geology of North America (1-6 credit hours)
Field study of classic geologic localities and geomorphic processes not indigenous to North Carolina. Typical areas: New England and adjacent Canada, northern Mexico and southwestern United States and Pacific Northwest. Representative subjects include Canadian Shield, Precambrian mineral deposits, San Andreas fault, desert geomorphology, Grand Canyon stratigraphy, modern and ancient reefs and glaciated volcanoes. Mineral, rock and fossil collecting. Required student reports.

Prerequisite: MEA 101 or MEA 120, Senior standing
Typically offered in Fall only

MEA 601 Seminar (1 credit hours)
Presentation by each student of one seminar on his/her current research.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MEA 611 Special Topics in Marine Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 612 Special Topics in Earth Sciences (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 613 Special Topics Atmospheric Sciences (1-6 credit hours)
Typically offered in Fall and Spring

MEA 630 Independent Study (3 credit hours)
Capstone project for the Climate Change and Society program. Students will carry out research in collaboration with an on-campus or off-campus partner in a climate-related sector. Students will address a real-world climate adaptation problem or issue and will prepare a written report describing the outcome of their research.

P: MEA 516, MEA 517, MEA 518, MEA 519, GIS 510
Typically offered in Fall, Spring, and Summer

MEA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MEA 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MEA 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

MEA 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

MEA 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MEA 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MEA 700 Environmental Fluid Mechanics (3 credit hours)
Basic concepts and laws governing motion of atmosphere and oceans developed from first principles, including approximations valid for environmental flows, kinematics, dynamics and thermodynamics of fluid flows as well as introduction to environmental turbulence. Credit is not allowed for both MEA 463 and MEA 700

Prerequisite: MA 241, PY 208
Typically offered in Fall only

MEA 703 Atmospheric Aerosols (3 credit hours)
An understanding of aerosols as primary air pollutants, indoor versus outdoor pollution, transformation processes, prediction of atmospheric concentrations, scavenging of aerosols, transport of air pollutants on a regional scale, discussion of national experiments to characterize and study impact of urban-industrial pollution, tropospheric aerosol and weather, stratospheric aerosol, effect of aerosols on atmospheric warming and cooling and air-quality models.

Prerequisite: (CH 201 or CH 203) and (PY 205 or PY 211), Corequisite: MEA 412
Typically offered in Spring only

MEA 705 Dynamic Meteorology (3 credit hours)
Brief review of classical and physical hydrodynamics; scale analysis of dynamic equations; atmospheric instabilities; dynamics of tropical convections; perturbation theory and approximations for atmospheric wave motions.

Prerequisite: MEA 422
Typically offered in Spring only

MEA 707 Planetary Boundary Layer (3 credit hours)
Review of basic equations and concepts of planetary boundary layers. The closure problem and semi-empirical theories of turbulence, buoyancy effects on mean flow and turbulence, instrumentation and observational platforms for PBL experiments, observed characteristics of atmospheric boundary layers, numerical and physical modeling of PBL and its parameterization in large-scale atmospheric circulation models.

Prerequisite: MEA 455 or MEA 721
Typically offered in Fall and Spring

MEA 708 Atmospheric Turbulence (3 credit hours)
Statistical description of turbulence, including probability, correlation and spectrum functions. Statistical theory of homogeneous turbulence, spectral dynamics and Kolmogorov's local similarity hypotheses. Effects of shear, thermal stratification and earth's rotation. Observed structure and scales of turbulence in PBL and free atmosphere. Higher-order closure models and large eddy simulations of atmospheric turbulence.

Prerequisite: MAE 550 or MEA 700 or MEA 707
Typically offered in Spring only

MEA 710 Atmospheric Dispersion (3 credit hours)
Lagrangian vs. Eulerian descriptions of turbulence and diffusion. Statistical theories of absolute and relative diffusion from continuous and instantaneous releases. Effects of shear, thermal stratification and earth's rotation on atmospheric dispersion. Lagrangian similarity theories of diffusion in the surface layer and mixed layer. Random walk, Monte Carlo and large eddy simulations of atmospheric dispersion. Urban and regional dispersion models.

Prerequisite: MAE 550 or MEA 700 or MEA 510
Typically offered in Fall only

MEA 712 Mesoscale Modeling (3 credit hours)
Modeling mesoscale weather phenomena including midlatitude cyclones, mesoscale convective complexes and squall lines. Application of finite difference, spectral and implicit methods and coordinate transforms to these problems. Utilization of explicit representations of moist processes. Development of parameterizations of convective clouds, planetary boundary layer and moist processes.

Prerequisite: MEA 705
Typically offered in Fall only

MEA 713 Mesoscale Dynamics (3 credit hours)
Inertia-gravity waves. Mechanical and thermally forced waves. Generation, circulation and maintenance of mesoscale convective storms and systems. Symmetric instability. Wave-CISK, quasi-geostrophic and semi-geostrophic fronts and fronto-genesis. Meso-B/Y frontogenesis. Lee and coastal cyclogenesis.

Prerequisite: MEA 700 and MEA 705
Typically offered in Fall only

MEA 714 Atmospheric Convection (3 credit hours)
Structure, physics and dynamics of convective clouds and cloud systems; fundamental equations for modeling convection; microphysical parameterization schemes; influence of instabilities on convective cloud systems; severe thunderstorms dynamics; tornadogenesis theories; mesoscale convective systems; upscale feedback effects of convection; cumulus parameterization schemes.

Prerequisite: MEA 412, MEA 700, MEA 705
Typically offered in Fall only

MEA 715 Dynamics of Mesoscale Precipitation System (3 credit hours)
Frontogenesis theory; inertial and conditional symmetric instability; mesoscale gravity waves and wave-CISK; conveyor belts; seeder-feeder processes and precipitation generating cells; classification and dynamics of precipitation band types.

Prerequisite: MEA 444
Typically offered in Fall only

MEA 716 Numerical Weather Prediction (3 credit hours)
Parameterization of physical processes in atmospheric modeling, including numerous hands-on experiments to allow evaluation and analysis of process representation in models. Emphasis on experimental design: Using numerical models as a tool with which to test scientific hypotheses. Investigation of data assimilation and ensemble prediction techniques. Journal discussion and student presentations are featured prominently. A semester project allows students to apply knowledge to thesis projects, and synthesize class concepts. Some comfort level with Linux computing environment, shell scripting, and programming languages such as FORTRAN required.

Typically offered in Fall and Spring

MEA 717 Advanced Weather Analysis (3 credit hours)
Evolution of physical and dynamic structure of synoptic and sesoscale storm systems occurring in middle and high latitudes. Recent advances in understanding these storm systems through intensive field experiments and computer modeling. Introduction to contemporary analysis techniques through laboratory exercises shedding light on storm structure, dynamics and scale interaction.

Prerequisite: MEA 444, MEA 705
Typically offered in Fall only

MEA 719 Climate Modeling (3 credit hours)
Climate system. Fundamental equations and time scales. Atmosphere, ocean, biosphere, cryosphere, lithosphere and hydrosphere subsystems. Computational numerical methods. Physical processes; atmosphere-ocean coupling, role of radiation, clouds and land surface processes. Climate anomalies due to changes in atmospheric composition, boundary conditions and extra-terrestrial forcing. Model validation, climate change detection, past climates and future climate scenarios.

Prerequisite: MEA 705
Typically offered in Fall only

MEA 721 Air-Sea Interaction (3 credit hours)
Review of basic equations and concepts of turbulent transfer in geophysical flows, air-sea interaction processes and their importance to man's activities, theory and observation of wind-generated ocean surface waves, turbulent transfers in planetaryboundary layer of marine atmosphere, oceanic mixed layer, development of thermocline and inversion.

Prerequisite: MEA 422 or MEA 560
Typically offered in Spring only

MEA 735 Fourier Analysis of Geophysical Data (3 credit hours)
Application of Fourier analysis to interpretation of low-frequency motions in ocean and atmosphere. Review of Fourier method. Filtering of tidal signals. Spectral estimates and calculation of current ellipses. Identification of coherent motions and their empirical orthogonal modes. Data from field experiments used in lectures and homework assignments.

Prerequisite: MA 341 and ST 511
Typically offered in Spring only

MEA 741 Synpotic Physical Oceanography (3 credit hours)
Basic discussion of the techniques and terminology of synoptic physical oceanography; focus on water characteristics and their relationship to currents in the individual oceans; a systematic quantitative description of the character of ocean waters and their movements.

Prerequisite: MEA 560
Typically offered in Spring only

MEA 743 Ocean Circulation (3 credit hours)
Basic study of mechanics of ocean circulation with emphasis on various simple models of circulation systems.

Prerequisite: MEA 700 or PY 411
Typically offered in Fall only

MEA 744 Dynamics of Shelf Circulation (3 credit hours)
Description and models of dynamic processes on the shelf, including seiches and tides in gulfs, propagation of tides and storm surges, wind-induced coastal upwelling, continental shelf waves and coastally trapped waves. Steady circulation driven by winds, river plumes and density forcing, formation of shelf-break fronts; and influence from deep-ocean currents.

Prerequisite: MEA 700
Typically offered in Fall only

MEA 752 Marine Plankton Ecology (3 credit hours)
Examination of worldwide relationships between physical-chemical environment and planktonic organisms. Organism descriptions; effects of light, temperature, salinity, density, water motion and chemical constituents on organisms; interactions among different organisms emphasizing competition and predation; community structure, distribution and succession; and mathematics models of distribution, production and interaction.

Prerequisite: BCH 451 and MA 121 and ZO 419
Typically offered in Fall only

MEA 759 Organic Geochemistry (3 credit hours)
Sources and fates of organic material in the geochemical environment. Microbial transformations of organic compounds. The use of biomarkers to study depositional environments. Petroleum, natural gas and coal formation. Extraterrestrial organic geochemistry.

Typically offered in Fall only

MEA 760 Biogeochemistry (3 credit hours)
Processes involved in the biogeochemical cycling of C, N, S and related biogenic elements. Stable isotopic and other geochemical signatures of biological processes. Introduction to modeling chemical distributions in sediments. The impact of biogeochemical processes on atmospheric chemistry.

Typically offered in Fall only

MEA 762 Marine Geochemistry (3 credit hours)
Detailed examination of chemical processes occurring in marine environment. Chemical evolution of the oceans, continental and submarine weathering, particle scavenging of reactive elements from water, column, formation of biogenic and metaliiferousdeposits, sediment diagenesis and marine geochronology.

Prerequisite: CH 331, MEA 560
Typically offered in Spring only

MEA 763 Isotope Geochemistry (3 credit hours)
This class offers an interdisciplinary introduction to the principles of isotope chemistry and its application to geological, atmospheric, and biological systems. Key topics include: isotope systematics; isotope measurements and analyses; common radiogenic (U, Ar, Pb, Sr, C, Be) and stable (H, O, C, N, S) isotope systems; applications to geochronology, paleobiology, paleoclimatology, environmental tracking, archeology, and more. This course is aimed at graduate students interested in using isotopes as a tool for examining the natural world.

Restriction: Graduate Standing or Permission of the Instructor
Typically offered in Spring only

MEA 779 Advanced Air Quality (3 credit hours)
Local, regional and global scale chemical interactions, transport and behavior of trace gases (sulfur carbon, nitrogen, hydrocarbon, and photo-chemical oxidants) in the atmosphere. covers three primary elements of air quality: anthropogenic and natural emissions of trace gases; interactions of the pollutants in the atmosphere; and monitoring and sampling of gaseous and particulate pollutants.

Prerequisite: (CH 201 or CH 203) and MEA(CE) 479
Typically offered in Spring only

MEA 785 Chemical Hydrogeology (3 credit hours)
Quantitative analysis of hydrological, geological, and geochemical factors controlling the transport and fate of organic and inorganic chemicals in groundwater. Acid-base, precipitation-dissolution, weathering, redox, complexation, sorption, and gas exchange reactions. Advection, diffusion, and dispersion in porous media, analytical solutions to the advection-dispersion equation. Non-aqueous-phase (organic) liquids.

Prerequisite: (CH 201 or CH 203) and (MEA 585 or CE 584)
Typically offered in Spring only

MEA 788 Advanced Structural Geology (3 credit hours)
Principles of rock mechanics and their application in solving geologic problems; finite strain analysis of deformed rocks; advanced techniques of structural analysis; petrofabrics; development of various geologic structures. Emphasis upon application of principles and techniques in the field.

Prerequisite: MEA 451
Typically offered in Fall only

MEA 789 Topics In Appalachian Geology (3 credit hours)
Examination of geology of areas within Appalachian orogenic belt. Lectures, discussions, reading and review of current literature and consideration of ideas concerning geological evolution of region. Required field trips.

Prerequisite: MEA 440, 450 and 451
Typically offered in Fall only

MEA 790 Geotectonics (3 credit hours)
In-depth examination of current ideas in plate tectonic theory. Plate tectonic controls on orogeny, orogenic belts, magmatism and metallogeny.

Prerequisite: MEA 440, 450, 451
Typically offered in Fall only

MEA 791 Advanced Special Topics in Marine Science (1-6 credit hours)
Opportunity for advanced undergraduate and graduate students to study timely special problem areas in Marine Science and Engineering

Typically offered in Fall, Spring, and Summer

MEA 792 Advanced Special Topics in Earth Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 793 Advanced Special Topics in Atmospheric Science (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 796 Exploration And Engineering Geophysics (3 credit hours)
Geophysical methods as applies to exploring the earth's mineral and energy resources and to investigating subsurface geological structure and physical properties. Principles, measurements, analyses, and interpretations of gravity, magnetic, electric, electromagnetic, seismic methods. Required research paper.

Prerequisite: MEA 470 or PY 208
Typically offered in Spring only

MEA 801 Seminar (1 credit hours)
Presentation by each student of one seminar on his/her current research.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MEA 810 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

MEA 811 Special Topics in Marine Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall, Spring, and Summer

MEA 812 Special Topics in Earth Sciences (1-6 credit hours)
Special topics in atmospheric science, provided to groups or to individuals.

Typically offered in Fall and Spring

MEA 813 Special Topics in Atmospheric Sciences (1-6 credit hours)
Special topics in earth sciences, provided to groups or to individuals.

Typically offered in Fall and Spring

MEA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planing for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MEA 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MEA 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Typically offered in Fall, Spring, and Summer

MEA 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MEA 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Materials Science and Engineering (MSE)

MSE 200 Mechanical Properties of Structural Materials (3 credit hours)
An introduction to the atomic and grain structure of structural materials emphasizing the mechanical properties. Effects of mechanical and heat treatments on structure and properties. Fatigue and creep of materials, fracture toughness, mechanical and non-destructive evaluation, effects of environment. Design considerations, characteristics of metals, ceramics, polymers and composites. Not for Materials majors

Prerequisite: Grade of C or better in CH 101
Typically offered in Fall, Spring, and Summer

MSE 201 Structure and Properties of Engineering Materials (3 credit hours)
Introduction to the fundamental physical principles governing the structure and constitution of metallic and nonmetallic materials and the relationships among these principles and the mechanical, physical and chemical properties of engineering materials.

Prerequisite: Grade of C or better in CH 101
Typically offered in Fall, Spring, and Summer

MSE 255 Experimental Methods for Structural Analysis of Materials (2 credit hours)
Principles and application of basic techniques for characterizing the structure of materials at different length scales. Optical microscopy, electron microscopy, scanning probe microscopy, X-ray diffraction and spectroscopic methods applied to metals, ceramics, polymers and semiconducting materials.

Corequisite: MSE 201
Typically offered in Spring only

MSE 260 Mathematical Methods for Materials Engineers (3 credit hours)
Use of MATLAB programming environment to illustrate and discuss principles and applications of analytical and numerical mathematical methods that are central to materials science and engineering. Data plotting, curve fitting, complex numbers and series, Fourier series and transforms, numerical integration and differentiation, linear algebra and matrix manipulation, initial and boundary value problems, numerical solution to ordinary differential equations and transport simulation through the use of partial differential equations.

Corequisite:MA 242
Typically offered in Spring only

MSE 270 Materials Science and Engineering Seminar (1 credit hours)
This course surveys the field of materials science and engineering and introduces students to contemporary issues. Job and career opportunities at the BS and graduate degree levels are presented. Students are introduced to opportunities for laboratory assistant jobs in the MSE department, summer internships, co-ops and summer research experiences at NCSU and other institutions. Students will learn to prepare effective resumes, technical reports and oral presentations.

Corequisite: MSE 201
Typically offered in Spring only

MSE 300 Structure of Materials at the Nanoscale (3 credit hours)
This course covers the structure of materials at the nanometer scale. Structure includes the periodic arrangements of atoms and ions in crystalline solids, the amorphous networks of atoms, ions, and molecules in glassy materials, and the molecular structure of polymeric and biological materials. The typical means of characterizing nanostructure are also reviewed. Finally, the course will introduce the structure of novel nanomaterials like nanotubes, buckyballs and self assembled monolayers.

P: C or better in MSE 201 or MSE 200
Typically offered in Fall only

MSE 301 Introduction to Thermodynamics of Materials (3 credit hours)
Review of classical thermodynamics and thermodynamic relationships. Use of statistical methods of describe entropy and other thermodynamic properties. Description of vapor-, liquid-, and solid-phase equilibrium in unary and other multicomponent material systems. Treatment of ideal and nonideal solution behavior in inorganic alloys and organic polymers. Application of gas-phase reaction kinetics and identification of the criteria required for reaction equilbria.

P: C or better in MSE 201 and MA 242
Typically offered in Fall only

MSE 320 Introduction to Defects in Solids (3 credit hours)
Classification of defects as point, line, surface or volume types. Geometrical and crystallographic aspects of defects. Defects in metallic, ionic and covalently bonded crystal structures. Physical, chemical, electronic and magnetic aspects of defects. Field quantities and forces associated with defects. Novel defects in nanostructured materials and semicrystalline materials.

Prerequisite: C or better in MSE 201
Typically offered in Fall only

MSE 335 Experimental Methods for Analysis of Material Properties (2 credit hours)
Principles and application of basic techniques for characterizing the properties of materials. Mechanical, thermal, electrical, optical and magnetic property measurements applied to metals, ceramics, polymers and semiconducting materials.

Prerequisite: C- or better in MSE 201
Typically offered in Fall only

MSE 355 Electrical, Magnetic and Optical Properties of Materials (3 credit hours)
Fundamental treatment of the electronic properties of materials, including the electrical, magnetic and optical characteristics. The role of electrons, band structure, and Bruillouin zones on the various classes of materials is discussed from the semiclassical and quantum mechanical viewpoints. Applications of these principles to specific technological devices is also covered.

Prerequisite: PY 208 and MA 341
Typically offered in Spring only

MSE 360 Kinetic Processes in Materials (3 credit hours)
Types, mechanisms, and kinetics of solid state phase transformations are covered with selected applications to all classes of materials. Mechanisms of diffusion and techniques for diffusion calculations are presented. The role of surface energy and strain in the evolution of structure during transformation is presented. Phenomena at different size scales (atomic, nano, micro) are described relative to the evolution of structure during transformation.

Prerequisite: MA 341 and MSE 301
Typically offered in Spring only

MSE 370 Microstructure of Inorganic Materials (3 credit hours)
Structure-property relationships in metallic and ceramic materials. Crystal structures of important metallic and ceramic elements, alloys, and compounds. Binary and ternary phase diagrams for notable systems will be presented. Microstructural features to be covered include grain size and distribution, multiphase microstructures, and defects. Examples of important metallic and ceramic systems for structural, electrical, optical and magnetic applications will be given.

Prerequisites: MSE 300, MSE 301, and MSE 320
Typically offered in Spring only

MSE 380 Microstructure of Organic Materials (3 credit hours)
Covers microstructure and properties of soft materials including polymer molecular weight distributions, amorphous polymers, semicrystalline polymers, copolymers, elastomers, biopolymers, soft tissue, bone and cellular structure. The design and function of implantable biomaterials are also covered.

Prerequisite: (CH 220 or CH 221) and MSE 300
Typically offered in Spring only

MSE 409/NE 509/MSE 509/NE 409 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.

Prerequisite: MSE 201
Typically offered in Fall only

MSE 420 Mechanical Properties of Materials (3 credit hours)
Basic concepts for mechanical properties of materials, elasticity, plasticity, viscoelasticity, rubber elasticity, strengthening mechanisms, creep, fracture and fatigue. Includes metals, ceramics, polymers and composites. Describes mechanical properties for nanostructured materials and biomaterials.

Prerequisite: MSE 370 and MSE 380
Typically offered in Fall only

MSE 423 Introduction to Materials Engineering Design (1 credit hours)
Materials selection in engineering design involving lecture, cooperative and problem-based learning techniques. Course stresses creative thinking, problem solving methodology, interdependence of design with analysis and evaluation, teamwork and sharpening of communication skills. Real industrial problems are introduced which are analyzed by student teams. This a half-semester course. The classroom lectures end at mid-semester. In the second half of the semester, student teams develop a proposal which is submitted to the industrial sponsors at the end of the semester. The proposal defines future work to be conducted under MSE 470. Senior standing in MSE.

Prerequisite: Senior standing in MSE
Typically offered in Fall only

MSE 440/MSE 540 Processing of Metallic Materials (3 credit hours)
Fundamental concepts of solidification and their application to foundry and welding practices; metal forming concepts applied to forging, rolling, extrusion, drawing, and sheet forming operations; machining mechanisms and methods; powder metallurgy;advanced processing methods including rapid solidification and mechanical alloying. Credit for both MSE 440 and MSE 540 is not allowed

Prerequisite: MSE 360 and MSE 370. Corequisite: MSE 420
Typically offered in Fall only

MSE 445/MSE 545 Ceramic Processing (3 credit hours)
Ceramic processing of powders includes powder synthesis, characterization, mixing, and size reduction. Theoretical aspects include particle packing, particles in suspension, and some aspects of surface chemistry. Forming methods include compaction, casting, and extrusion. Firing and sintering are examined. Credit for both MSE 445 and MSE 545 is not allowed

Prerequisite: MSE 370
Typically offered in Fall only

MSE 455 Polymer Technology and Engineering (3 credit hours)
This course will cover commercial polymers, polymer blends and miscibility, dynamic mechanical behavior, Boltzmann superposition principle, ultimate properties of polymers, polymer rheology and processing, recycling and design and selection of polymeric materials. Guest instructors from industry will give presentations on contemporary topics in polymer technology and engineering. Field trips are required.

Prerequisite: MSE 380
Typically offered in Spring only

MSE 456/MSE 556 Composite Materials (3 credit hours)
The course covers the basic principles underlying properties of composite materials as related to the properties of individual constituents and their interactions. Polymer, metal and ceramic matrix composites are included. Property averaging and micromechanics of composites are covered at an introductory level. Emphasis is placed on design and processing of composite systems to yield desired combinations of properties. Credit for both MSE 456 and MSE 556 is not allowed.

Prerequisite: MSE 420
Typically offered in Spring only

MSE 460 Microelectronic Materials (3 credit hours)
Processes and characterization techniques relevant to microelectronic materials science and technology. Boule growth, wafer preparation, oxidation, epitaxial growth, doping techniques, metallization, and device applications of elemental and compound semiconductors. Electrical, structural and chemical characterization of semiconductors is included as well as materials considerations relevant to device fabrication. Credit for both MSE 460 and MSE 560 is not allowed

Prerequisite: MSE 355
Typically offered in Fall only

MSE 465/MSE 565 Introduction to Nanomaterials (3 credit hours)
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications and contemporary literature.

Prerequisite: MSE 201
Typically offered in Spring only

MSE 470 Materials Science and Engineering Senior Design Project (3 credit hours)
Design project in materials science and engineering requiring problem definition and analysis, synthesis, and presentation of a designed solution. Students work in groups with a faculty adviser on problems submitted by local industrial sponsors or emerging research issues that represent the major specialty areas including ceramics, metals, polymers, or electronic materials.

Prerequisite: MSE 423
Typically offered in Spring only

MSE 480/MSE 580 Materials Forensics and Degradation (3 credit hours)
Covers principles and prevention of the degradation of materials. The topics will include dissolution of polymer and ceramic materials, electrochemical corrosion, oxidation of metals and polymers, degradation of polymers, friction and wear, degradation of electrical device components, bio-deterioration of materials, and failure analysis. The general practice in failure analysis will be applied to a variety of case studies to illustrate important failure mechanisms. Credit will not be given for both MSE 480 and MSE 580.

Prerequisite: MSE 370 and MSE 380
Typically offered in Spring only

MSE 485 Biomaterials (3 credit hours)
The course introduces fundamental aspects associated with synthesis, properties, processing/fabrication and application of materials derived from or associated with bio-entities. The course focuses on biomaterials with broad applications beyond medical or clinical uses. The course emphasizes the biological systems unique machinery and function in the context of desired outcome that utilizes a material or materials' systems. Fundamental concepts covered in the course include: differences among classes of biomaterials; toxicity vs biocompatibility of biomaterials; bulk vs surface properties of biomaterials; interactions of biomaterials with different environments; biomaterials stability and degradation; biomaterials for sensing and bioelectronics applications; biomaterials for energy, soft robotics and responsive materials applications; and biomaterials for drug delivery.

Prerequisite: MSE 201 and BIO 183
Typically offered in Spring only

MSE 489/MSE 589/PY 489/PY 589/ECE 489/ECE 589 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

MSE 490 Special Topics in Materials Engineering (1-4 credit hours)
Offered as needed for the development of new courses in materials engineering, including areas such as metals, ceramics, polymers, or microelectronic materials.

MSE 495 Materials Engineering Projects (1-6 credit hours)
Application of engineering principles to a specific materials engineering project by a student or small group of students under supervision of a faculty member. A written report required.

Prerequisite: Junior standing or Senior standing
Typically offered in Fall, Spring, and Summer

MSE 500 Modern Concepts in Materials Science (3 credit hours)
Fundamentals of structure, structure modification and properties of materials with emphasis on structure-property relationships and modern theory of solids.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MSE 509/NE 409/MSE 409/NE 509 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.

Prerequisite: MSE 201
Typically offered in Fall only

MSE 531 Physical Metallurgy (3 credit hours)
Application and design of selected metals and alloys in a theoretical and practical context. Relationships between mechanical behavior, and alloy chemistry, microstructure, and processing. Corrosion resistance; fatigue failure; creep; brittle fracture. Design of specific microstructures. Credit for both MAT 431 and MSE 531 is not allowed

Prerequisite: MAT 321, MAT 450, Corequisite: MAT 430
Typically offered in Fall only

MSE 539/MAE 539 Advanced Materials (3 credit hours)
Introduces production/structure/property/function relation and application of a number of materials mainly for biomedical, mechanical and aerospace applications. Topics include ultra light materials (production, processing and applications of cellular solids), biomaterials (classes and application of materials in medicine and dentistry), composites (classes and application), refractory materials and coatings for high temperature applications, thin film shape memory alloys for micro-electro mechanical systems (MEMS).

Prerequisite: MSE 201 and MAE 314
Typically offered in Fall only

MSE 540/MSE 440 Processing of Metallic Materials (3 credit hours)
Fundamental concepts of solidification and their application to foundry and welding practices; metal forming concepts applied to forging, rolling, extrusion, drawing, and sheet forming operations; machining mechanisms and methods; powder metallurgy;advanced processing methods including rapid solidification and mechanical alloying. Credit for both MSE 440 and MSE 540 is not allowed

Prerequisite: MSE 360 and MSE 370. Corequisite: MSE 420
Typically offered in Fall only

MSE 545/MSE 445 Ceramic Processing (3 credit hours)
Ceramic processing of powders includes powder synthesis, characterization, mixing, and size reduction. Theoretical aspects include particle packing, particles in suspension, and some aspects of surface chemistry. Forming methods include compaction, casting, and extrusion. Firing and sintering are examined. Credit for both MSE 445 and MSE 545 is not allowed

Prerequisite: MSE 370
Typically offered in Fall only

MSE 555 Polymer Technology and Engineering (3 credit hours)
Classes of commercially important polymers, advanced topics in phase behavior, viscoelasticity, fracture and ultimate properties of polymers; polymer rheology, and processing; design of polymeric materials. Credit for both MSE 455 and MSE 555 is not allowed.

Prerequisite: MSE 424 or equivalent
Typically offered in Spring and Summer

MSE 556/MSE 456 Composite Materials (3 credit hours)
The course covers the basic principles underlying properties of composite materials as related to the properties of individual constituents and their interactions. Polymer, metal and ceramic matrix composites are included. Property averaging and micromechanics of composites are covered at an introductory level. Emphasis is placed on design and processing of composite systems to yield desired combinations of properties. Credit for both MSE 456 and MSE 556 is not allowed.

Prerequisite: MSE 420
Typically offered in Spring and Summer

MSE 560 Microelectronic Materials Science and Technology (3 credit hours)
Processes and characterization techniques relevant to microelectronic materials science and technology. Boule growth, water preparation, oxidation, epitaxial growth, doping techniques, metallization, and device applications of elemental and compound semiconductors. Electrical, structural and chemical characterization of semiconductors as well as materials considerations relevant to device fabrication. Credit for both MAT 460 and MSE 560 is not allowed

Prerequisite: MAT 331, Corequisite: MAT 431
Typically offered in Fall only

MSE 561/TC 561 Organic Chemistry Of Polymers (3 credit hours)
Principles of step reaction and addition polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.

Prerequisite: TC 461 and CH 231 or CH 431

MSE 565/MSE 465 Introduction to Nanomaterials (3 credit hours)
Introduction to nanoparticles, nanotubes, nanowires, and nanostructured films, emphasizing their synthesis, structural and property characterization, novel physical and chemical properties, applications and contemporary literature.

Prerequisite: MSE 201
Typically offered in Spring only

MSE 566 Mechanical Properties of Nanostructured Materials (3 credit hours)
The course covers mechanical behavior that is unique to nanostructured materials Â¿ typically nanocrystalline metals and alloys. The various methods for processing nanostructured materials will be presented, emphasizing those that are suitable for mechanical property studies. The thermal stability of nanocrystalline microstructures will be covered and strategies for inhibiting grain growth described. Mechanical testing methods for uniaxial loading, creep, fracture and fatigue will be covered. Testing methods will also be discussed in context with structure-property relations, deformation mechanisms and failure modes.

Prerequisite: MSE 500 or an instructor approved equivalent.
Typically offered in Spring only

MSE 576/MBA 576 Technology Entrepreneurship and Commercialization I (3 credit hours)
First course in a two-course entrepreneurship sequence focusing on opportunities for technology commercialization. Evaluation of commercialization of technologies in the context of new business startups. Emphasis is placed on creating value through technology portfolio evaluation and fundamentals of technology-based new business startups. This includes development of value propositions and strong technology-product-market linkages. The process based approach is appropriate for new business startup as well as entrepreneurship in existing organizations through spinoffs, licensing, or new product development. Credit not allowed for MBA 576 if the student has already taken MBA 570 or MBA 571.

Credit not allowed in MBA 576 if the student has already taken MBA 570 or MBA 571
Typically offered in Fall and Spring

MSE 577/MBA 577 Technology Entrepreneurship and Commercialization II (3 credit hours)
Continuation of evaluation of technologies for commercialization through new business startups. Emphasis is placed on creating value through strong technology-products-markets linkages using the TEC algorithm. Topics include industry and market testing of assumptions, legal forms of new business startups, funding sources and creating a quality, integrative new business startup plan. Credit not allowed in 577 for students who have already taken 570 or 571.

Prerequisite: MBA/MSE 576. Credit not allowed in 577 for students who have already taken 570 or 571.
Typically offered in Spring only

MSE 580/MSE 480 Materials Forensics and Degradation (3 credit hours)
Covers principles and prevention of the degradation of materials. The topics will include dissolution of polymer and ceramic materials, electrochemical corrosion, oxidation of metals and polymers, degradation of polymers, friction and wear, degradation of electrical device components, bio-deterioration of materials, and failure analysis. The general practice in failure analysis will be applied to a variety of case studies to illustrate important failure mechanisms. Credit will not be given for both MSE 480 and MSE 580.

Prerequisite: MSE 370 and MSE 380
Typically offered in Spring only

MSE 589/PY 489/PY 589/ECE 489/ECE 589/MSE 489 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

MSE 591 Special Topics In Materials Science and Engineering (1-4 credit hours)
Topics of current interest in Materials Science and Engineering not covered in existing courses.

Typically offered in Fall and Spring

MSE 601 Seminar (1 credit hours)
Reports and discussion of special topics in materials science and engineering and allied fields.

Typically offered in Fall and Spring

MSE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Summer only

MSE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 695 Master's Thesis Research (1-9 credit hours)
Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MSE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MSE 702 Defects In Solids (3 credit hours)
Prerequisite: MSE 500
Typically offered in Spring only

MSE 703 Interaction of Electrons with Materials (3 credit hours)
This course reviews basic interaction of electrons with solids through the free electron theory, quantum mechanics and quantum phenomena, and band theory. The course provides a practical foundation for understanding of electrical behavior of metals, semiconductors, dielectrics and non-crystalline materials and how this behavior relates to structure and materials processing. Graduate standing in MSE, CBME, ECE, PY, CH, or consent of the instructor required.

Prerequisite: MSE 500
Typically offered in Fall only

MSE 704 Interaction of Photons with Materials (3 credit hours)
This course will answer basic questions on photon-matter interaction: Why do materials appear the way we see them? How can we change and control that? How can we apply their optical properties in various optical elements and optoelectronic devices? The course provides a practical foundation for working with and developing of materials for modern optoelectronic and photonic technologies. Graduate standing in MSE, CBME, ECE, PY, CH, or consent of the instructor required.

Prerequisite: MSE 703
Typically offered in Spring only

MSE 705 Mechanical Behavior Of Engineering Materials (3 credit hours)
Coverage of both fundamental and engineering aspects of mechanical behavior of materials. Elasticity, plasticity and dislocation theory concepts used to describe phenomenological behavior and micro-mechanical mechanisms. Strengthening mechanisms in crystals, high-temperature deformation, fracture mechanics, fracture toughening mechanisms and cyclic deformation.

Prerequisite: MAT 450, MAT 702
Typically offered in Spring only

MSE 706 Phase Transformations and Kinetics (3 credit hours)
Homogeneous and heterogeneous nucleation, spinodal decomposition, interface and diffusion-controlled growth, formal theory of transformation kinetics, precipitation, coarsening, order-disorder, and martensitic transformations.

Prerequisite: MAT 700, MAT 710, and MSE 500
Typically offered in Spring only

MSE 708 Thermodynamics Of Materials (3 credit hours)
Review of first and second laws of thermodynamics, equilibrium and irreversible processes, open and closed systems, partition functions and particle distribution functions. Applications include extension of thermodynamic potentials to situations where electrical, magnetic and stress fields present, heat capacity of crystals, electron gas in metals, solution models, binary phase diagrams and rubber elasticity in polymers.

Prerequisite: MAT 301 and MSE 500
Typically offered in Fall only

MSE 709 Metastable Materials: Processing, Structure, and Properties (3 credit hours)
The thermodynamics and kinetics of the synthesis and stability of a variety of important metastable materials - those materials that are not in the lowest free energy state for the composition and structure - will be described. The common methods for non-equilibrium processing will be covered. A significant part of the course will be devoted to amorphous materials, including their synthesis, structure, and properties. Other topics will include quasi-crystalline materials, metastable crystalline materials, and shape memory alloys. As background for shape memory alloys, diffusionless phase transformations with emphasis on martensitic transformations will be reviewed.

Prerequisite: MSE 500 or Instructor Consent
Typically offered in Fall only

MSE 710 Elements Of Crystallography and Diffraction (3 credit hours)
Crystal symmetry, lattices and space groups; elementary diffraction by crystalline matter; experimental methods of x-ray diffraction.

Typically offered in Fall only

MSE 712 Scanning Electron Microscopy (3 credit hours)
Electron optics, sources and detectors. Beam specimen interactions, secondary and backscattered electrons, and EDS. Resolution limits, experimental conditions, related techniques, beam-induced damage and materials modifications.

Typically offered in Fall only

MSE 715 Fundamentals Of Transmission Electron Microscopy (4 credit hours)
Electron optics, electron-solid interactions, electron diffraction, image contrast, defect characterization, analytical and high resolution microscopy. Parallel laboratory demonstrations and exercises. Laboratory enrollment limited to twelve, but laboratory may be waived with consent of instructor.

Prerequisite: MAT 710
Typically offered in Spring only

MSE 718 Advanced Transmission Electron Microscopy (3 credit hours)
This course provides the advanced graduate student with a detailed knowledge of transmission electron microscopy covering: advanced topics in electron sources, details of electron optics and aberrations, aberration corrected electron microscopy, modeling and simulating interactions of electrons with the specimen, image processing and analysis, and analytical techniques (EELS and EDX). Graduate standing in MSE, CHE, ECE, PHY, CH required or consent of the instructor.

Prerequisite: MSE 715
Typically offered in Fall only

MSE 721 Nanoscale Simulations and Modeling (3 credit hours)
The course is designed to assist engineering students in learning the fundamentals and cutting-edge nature of various simulations methods. The modeling tools range from accurate first principles quantum-based approaches to multi-scale approaches that combine atomic and continuum modeling. Previous knowledge of simulations is not required. The course is appropriate for graduate students in materials science, engineering, chemistry, physics and biomedical fields.

Typically offered in Fall only

MSE 723 Materials Informatics (3 credit hours)
The course aims to introduce the emergent field of materials informatics and current approaches that employ informatics and experimental and computational data to accelerate the process of materials optimization, discovery and development. An emphasis will be placed on practical implementation of machine learning techniques to various materials science problems.

Typically offered in Fall only

MSE 731/MAE 731 Materials Processing by Deformation (3 credit hours)
Presentation of mechanical and metallurgical fundamentals of materials processing by deformation. Principles of metal working, friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

Prerequisite: Six hrs. of solid mechanics and/or materials
Typically offered in Fall only

MSE 741 Principles of Corrosion (3 credit hours)
Fundamentals of metallic corrosion and passivity. Electro-chemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work included.

Prerequisite: MAT 201 and CH 431 or MAT 301

MSE 751 Thin Film and Coating Science and Technology I (3 credit hours)
Vacuum science and technology including gas kinetics, gas flow calculations, system design and use of various pumps, materials and components. Atomistics of solid surfaces. Nucleation and growth of films and coatings.

Prerequisite: MAT 700
Typically offered in Spring only

MSE 752 Thin Film and Coating Science and Technology II (3 credit hours)
Techniques for thin films and coatings deposition and their applications. Interfaces, adhesion and surface modification. Artificially structured and chemically modulated layered materials. Pseudomorphic structures. Characterization of thin films andcoatings.

Prerequisite: MSE 751
Typically offered in Spring only

MSE 757 Radiation Effects on Materials (3 credit hours)
Interaction of radiation with matter with emphasis on microstructural modification, physical and mechanical effects. Defects generation and annealing, void swelling, irradiation growth and creep, and irradiation induced effects in reactor materialsare discussed. Current theories and experimental techniques are discussed.

Typically offered in Spring only

MSE 760 Materials Science in Processing of Semiconductor Devices (3 credit hours)
Ion implantation and doping for advanced semiconductor devices, thin films and epitaxy, silicides, ohmic contacts and interconnection metallurgy, oxidation and nitridation, gettering of impurities and dopant segregation phenomena, electromigration, electronic packaging materials science and advanced device concepts.

Prerequisite: MAT 460 and MSE 500
Typically offered in Fall only

MSE 761/CHE 761 Polymer Blends and Alloys (3 credit hours)
Thermodynamics, morphological characteristics and properties of multiphase polymer systems composed of homopolymers or copolymers. Interfacial characteristics and modification of multicomponent polymer blends through emulsification and reactive blending. Microphase ordering in block copolymers, and emerging technolgies employing these nanostructured materials. Conformational properties and dynamics of macromolecules constrained near an interface.

Prerequisite: CHE 316 or MAT 301
Typically offered in Fall only

MSE 763/TMS 763 Characterization Of Structure Of Fiber Forming Polymers (3 credit hours)
Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state. Characterization methods include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance.

Prerequisite: Graduate standing
Typically offered in Fall only

MSE 770 Defects, Diffusion and Ion Implantation In Semiconductors (3 credit hours)
Thermodynamics of vacancies and interstitials, defect complexes, electronic defects, defect annealing processes, self diffusion, dopant and impurity diffusion, substitutional/interstitial diffusion, diffusion in amorphous solids, electro transport, fundamentals of ion-solid interactions, semiconductor doping atomic structure of defects, damage annealing processes, supersaturated alloys, laser annealing, ion beam mixing phenomena, ion implantation and rapid thermal annealing processes, shallow junctions and devices.

Prerequisite: MAT 701
Typically offered in Spring only

MSE 771 Materials Science of Nanoelectronics (3 credit hours)
Effects of scale less than 100 nm on the electrical properties & processing of all materials (metals, semiconductors, ceramics, polymers and biomaterials). Current status and future prospects for the semiconductor industry summarized by invited scientists and by review and discussion of selected current literature. Student presentations and research proposals are required.

Prerequisite: MSE 500
Typically offered in Fall only

MSE 775 Structure of Semicrystalline Polymers (3 credit hours)
Structure and organization of semicrystalline polymers, from molecular scale to bulk state, including chain configuration, unit cell geometries, polymer crystallography, single crystals, spherulites, epitaxial crystallization, morphology, crystal defects, annealing and deformation mechanisms. Emphasis on analysis of x-ray diffraction, electron diffraction and electron microscopy data for structural characterization.

Prerequisite: MAT 425
Typically offered in Fall only

MSE 791 Advanced Topics in Materials Science and Engineering (1-3 credit hours)
Special studies of advanced topics in materials science and engineering.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MSE 795 Advanced Materials Experiments (1-3 credit hours)
Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period provided; required written report.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

MSE 801 Seminar (1 credit hours)
Reports and discussion of special topics in materials science and engineering and allied fields.

Typically offered in Fall and Spring

MSE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

MSE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MSE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MSE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Math & Science Education (EMS)

EMS 204 Introduction to Mathematics Education (2 credit hours)
This course introduces students to the teaching of Mathematics in middle and high schools. Students will become familiar with state mathematics standards and national recommendations for teaching mathematics. The course has a required fieldwork component in local K-12 schools, and students are responsible for their own transportation to and from the schools. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Managemnt for details on acquiring the insurance and the current charge. This course is restricted to Teacher Education majors.

Prerequisite: ED 100; Corequisite: ED 204
Typically offered in Fall and Spring

EMS 205 Introduction to Teaching Science (2 credit hours)
Introduces perspective teachers to the teaching of science in the middle school and high school. Topics include nature of the science learner, common alternative conceptions in science, introduction to science teaching strategies, and the science curriculum in middle and high school. Sophomore status or higher is required. Sophomore status or higher is required.

Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Spring only

EMS 296 Special Topics in Education (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels. Specific topics will vary from semester to semester.

EMS 350 Teaching Environmental Education (3 credit hours)
This course is designed to provide disciplinary and interdisciplinary overviews of environmental education. Students will learn a range of research-supported practices in environmental education that are effective for youth and adults. Topics include a variety of methods for teaching and assessing environmental education.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

EMS 373 Instructional Materials in Science (3 credit hours)
Development and selection of teaching materials that reflect concepts of content and emphasis in middle and secondary school science. Experimental and laboratory approaches, including use of microcomputer and video technologies.2 lecture hours and 6 lab hours per week for 7 weeks

Prerequisite or Corequisite: EMS 205 and ED 204
Typically offered in Fall only

EMS 375 Methods of Teaching Science I (3 credit hours)
Classroom, laboratory, and internship experiences for pre-service teachers to effectively prepare, plan and assess learning environments in the middle and secondary science classroom and instructional laboratory. Emphasis placed on knowledge, skills, and dispositions for inquire-based learning environments.

Prerequisite: EMS 205, ED 204
Typically offered in Spring only

EMS 470/EMS 570 Methods and Materials for Teaching Mathematics (3 credit hours)
Purposes, methods, curricula, and evaluation practices for teaching mathematics in middle and high school levels.

Prerequisite: C or better in EMS 480 and EMS 472 or EMS 474 and admittance to Teacher Candidacy.
Typically offered in Fall only

EMS 471 Student Teaching in Mathematics (1-12 credit hours)
Supervised experience in a selected middle or secondary school for the semester, to develop and practice the skills and techniques for teaching mathematics. Students are required to provide their own transportation. MED, MSM and MSD majors only.

Prerequisite: Admission to professional semester, Completion of EMS 470 with a C or better; Corequisite: EMS 495
Typically offered in Spring only

EMS 472/EMS 572 Teaching Mathematics Topics in Senior High School (3 credit hours)
Preparation for teaching mathematics in grades 9-12. This course includes a school-based field experience. Students are required to provide their own transportation. MED Majors only.

Prerequisite: Admittance to Teacher Candidacy
Typically offered in Spring only

EMS 474 Teaching Mathematics Topics in the Middle Grades (3 credit hours)
Methods of teaching arithmetic, geometry, algebra, and pre-algebra topics in grades 6-9. Emphasizes approaches that actively involve learners and relate operations on concrete and pictorial representations to mathematical symbols. This course includes a school-based field experience. Students are required to provide their own transportation. MSM Majors only.

Prerequisite: Admittance to Teacher Candidacy
Typically offered in Spring only

EMS 475 Methods of Teaching Science II (3 credit hours)
Goals, methods, curricula, and evaluation practices in teaching the physical and biological sciences at the middle and secondary school levels.Taught during the fall.

Prerequisite: EMS 375
Typically offered in Fall only

EMS 476 Student Teaching in Science (1-12 credit hours)
Supervised experience in a selected middle or secondary school for the semester, to develop and practice the skills and techniques for teaching Science. Students are required to provide their own transportation. SED and MSS majors only. Students are required to purchase internships liability insurance to participate in student teaching. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

Prerequisite: EMS 475; and Corequisite: EMS 495
Typically offered in Spring only

EMS 480/EMS 580 Teaching Mathematics with Technology (3 credit hours)
Prepares prospective mathematics teachers to use technology in their classrooms to assist students in formulating and solving math problems in the middle and high school mathematics curricula.

Prerequisite: EMS 204 with a B- or better; MA 131 or 141
Typically offered in Spring only

EMS 490 School Mathematics from an Advanced Perspective (3 credit hours)
This course will serve as a culminating experience for all students majoring in mathematics education and intending to become secondary mathematics teachers. Course content includes functions in both secondary and collegiate mathematics, development of euclidean geometry from euclid's elements, and historical overview of algebra, and other mathematics subject matter, a trigonometry review from both triangle basis and function basis, connections between linear algebra and the high school presentation of matrices, and other topics. For Math Education majors only.

Prerequisite: MA 403 or MA 407, MA 308 or MA 408, MA 205 or MA 305 or MA 405
Typically offered in Fall only

EMS 495 Senior Seminar in Mathematics and Science Education (1-3 credit hours)
In-depth investigation of one or more teaching areas in mathematics or science education.

Prerequisite: Advanced Undergraduate standing
Typically offered in Spring only

EMS 496 Special Topics in Education (1-3 credit hours)
Individual or group study of special topics in professional education. The topic and mode of study are determined by the faculty member after discussion with the student.

Prerequisite: Junior or senior standing

EMS 505 Methods of Teaching Science I (3 credit hours)
Graduate students new to science teaching will read current research literature that defines best practices and incorporate these practices to lesson planning that enhances student learning. Classroom, laboratory, and school-based experiences in middle and secondary science classrooms and instructional laboratories will help students to effectively prepare, plan, and assess learning environments. Emphasis placed on the development of knowledge, skills, and dispositions for inquiry-based learning environments. Underlying theoretical framework is constructivism, and experiences will be discussed using current learning theory. PBS or Graduate Standing.

Typically offered in Spring only

EMS 506 Methods of Teaching Science II (3 credit hours)
This course is designed to provide graduate-level pre-service teachers with meaningful and practical learning experiences that will prepare them to create effective science learning environments for secondary school age students and to construct a vision of themselves as a teacher of secondary science. In the course, pre-service teachers will have opportunities to apply research-supported best practices to planning and enacting science lessons and to critically analyze current trends, issues and problems in science education.

Typically offered in Fall only

EMS 510 Interactions In the Mathematics Classroom (3 credit hours)
This course focuses on interactions between students and teachers in the mathematics classroom. Topics studied will include: whole class instruction, small group activity, questioning and facilitating classroom discussion. This course will include a field experience in the schools for which students will be required to provide their own transportation. Course restricted to mathematics education students in the MED, MS or MAT programs.

Typically offered in Spring only

EMS 512 Teaching and Learning Elementary and Middle Grades Mathematics (3 credit hours)
Focus on theory, research, and methodology of teaching and learning mathematics in elementary and middle grades. Emphasizes the development of a foundation for understanding and assessing mathematical growth and learning through historical and psychological sources, research, and reflective practice. Emphasis is placed upon understanding how children come to learn elementary mathematics meaningfully and what this necessarily implies about the way mathematics is taught and how elementary and middle grades education can be improved.

Prerequisite: EMS 471
Typically offered in Fall only

EMS 513 Teaching and Learning of Algebraic Thinking (3 credit hours)
Teaching and learning of algebra from a developmental perspective; research-based methods for developing students' algebraic thinking; structure and processes used in algebra. Focus on how students develop algebraic ideas from upper elementary grades through Algebra I.

Prerequisite: EMS 471 or equivalent teaching experience.
Typically offered in Fall only

EMS 514 Teaching and Learning of Geometric Thinking (3 credit hours)
Focus will be on the development of geometric thinking in grades K-12 using multiple instructional approaches, including technology, and considered using different theories of learning and frameworks (e.g., Van Hiele, SOLO taxonomy). Topics may include: measurement, similarity, congruence, properties of 2 and 3 dimensional figures, circles, non-Euclidean geometries. Synthetic, analytic and transformational, formal and informal approaches will be highlighted.

Prerequisite: EMS 471 and either MA 308 or MA 408
Typically offered in Fall only

EMS 519/ST 519 Teaching and Learning of Statistical Thinking (3 credit hours)
This course is designed to bridge theory and practice on how students develop understandings of key concepts in data analysis, statistics, and probability. Discussion of students' understandings, teaching strategies and the use of manipulatives and technology tools. Topics include distribution, measures of center and spread, sampling, sampling distribution, randomness, and law of large numbers. Must complete a first level graduate statistics course (ST 507, ST 511, or equivalent) before enrolling.

Prerequisite: ST 507 or ST 511
Typically offered in Spring only

EMS 521 Advanced Methods in Science Education I (3 credit hours)
Contemporary learning theories and current research will guide students to create effective science learning environments for all students. Students will engage in critical analysis of current trends, issues and problems in science education in terms of multiple perspectives. Students will also have opportunities to contemplate what it means to teach science, what it means to teach a diverse population of students and how to develop, interpret, and implement alternative assessment.

Prerequisite: Graduate Standing in MAT: STEM-Science Education and Doctoral Standing in Learning and Teaching in STEM
Typically offered in Fall only

EMS 522 Advanced Methods in Science Education II (3 credit hours)
Examines science instruction through analysis of curriculu, instructional practices, current research on science learning and teaching. Five areas of interest: curriculum, instruction, assessment, diversity, learning environments and technology in science education.

R: Graduate Standing in MAT: STEM-Science Education
Typically offered in Fall only

EMS 531 Introduction to Research in Science Education (3 credit hours)
Introduction to science education research, within two focal areas. One focus is to learn to read, understand, evaluate, and apply published educational research in your own practice, with scaffolding to support your understanding of techniques and designs specific to and/or in the context of science education research. Another focus is to learn to conduct research in order to improve your effectiveness as an educator or solve educational problems. You will learn about ethics connected with research and will perform and interpret quantitative and/or qualitative analyses commonly used in science education research while carrying out a research project that you designed. You will learn about how research papers are structured and organized, and communicate your research findings in both oral and written form.

Prerequisite: Graduate standing in Science Education
Typically offered in Spring only

EMS 570/EMS 470 Methods and Materials for Teaching Mathematics (3 credit hours)
Purposes, methods, curricula, and evaluation practices for teaching mathematics in middle and high school levels.

Prerequisite: C or better in EMS 480 and EMS 472 or EMS 474 and admittance to Teacher Candidacy.
Typically offered in Fall only

EMS 572/EMS 472 Teaching Mathematics Topics in Senior High School (3 credit hours)
Preparation for teaching mathematics in grades 9-12. This course includes a school-based field experience. Students are required to provide their own transportation. MED Majors only.

Prerequisite: Admittance to Teacher Candidacy
Typically offered in Spring only

EMS 573 Design of Tools and Learning Environments in STEM Education (3 credit hours)
The course aims to develop: familiarity with research related to the teaching and learning of STEM content within technological learning environments, advanced knowledge of the ways technology can support teaching and learning in STEM, and ability to design technology-enabled learning experiences. Course activities are designed to enhance understandings and applications of technological tools within and across STEM disciplines.

Restriction: Graduate standing in STEM Education
Typically offered in Fall and Spring

EMS 575 Foundations Of Science Education (3 credit hours)
Study and analysis of philosophical, historical, sociological, political and economic factors affecting science education in schools of the U.S. Implications for science education of various learning theories along with models for curriculum development and program planning.

Prerequisite: Graduate standing in Science Education
Typically offered in Spring only

EMS 577 Improving Classroom Instruction In Science (3 credit hours)
Application of major principles of education and psychology to improvement of science teaching in elementary, middle and secondary schools. Emphasis on critical analysis of research and the development of research-based classroom applications. Goalsand objectives of science teaching, instructional strategies, development or selection of science materials, evaluation of achievement and elements of a desirable classroom climate.

Prerequisite: EMS 475
Typically offered in Spring only

EMS 580/EMS 480 Teaching Mathematics with Technology (3 credit hours)
Prepares prospective mathematics teachers to use technology in their classrooms to assist students in formulating and solving math problems in the middle and high school mathematics curricula.

Prerequisite: EMS 204 with a B- or better; MA 131 or 141
Typically offered in Spring only

EMS 581 Advanced Applications of Technology in Mathematics Education (3 credit hours)
Research-based applications of technology tools in secondary and middle school mathematics. Advanced use of various technology tools for learning and teaching mathematics, including design of technology environments, appropriate investigation tasks, and professional development.

Typically offered in Spring only

EMS 592 Special Problems In Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

Prerequisite: EMS 471
Typically offered in Fall, Spring, and Summer

EMS 594 Special Problems In Science Teaching (1-3 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.

Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 621 Special Problems In Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

Prerequisite: EMS 471
Typically offered in Summer only

EMS 622 Special Problems In Science Teaching (1-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.

Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 630 Independent Study in EMS (1-3 credit hours)
Detailed investigation of topics of particular interest to graduate students under faculty direction on a tutorial basis. Determination of credits and content by faculty member in consultation with department head.

Typically offered in Fall and Spring

EMS 641 Practicum In Science and Mathematics Education (1-6 credit hours)
Supervised practicum in appropriate settings both on- and off-campus. Provision for opportunity for development, implementation and evaluation in science and mathematics in clinical environment under faculty supervision.

Prerequisite: EMS 770 or EMS 775
Typically offered in Fall and Spring

EMS 651 Internship In Mathematics And Science Education (1-9 credit hours)
Utilizing the participant-observed role, required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences of selected course of action.

Prerequisite: Nine hrs. in grad. level courses
Typically offered in Fall, Spring, and Summer

EMS 675 Portfolio Development (1 credit hours)
Techniques of portfolio construction for documenting attainment of advanced competencies in science training.For students in the last or next to last semester of coursework in the Science Education Masters Program.

Typically offered in Fall only

EMS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

EMS 686 Teaching In College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures andother types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Summer only

EMS 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EMS 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring and Summer

EMS 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

EMS 692 Research Projects In Mathematics and Science Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of the graduate faculty. The research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

EMS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EMS 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EMS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

EMS 699/EOE 699/EAC 699/ECD 699/ECI 699/ELP 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

EMS 703 Teaching Mathematics and Science In Higher Education (3 credit hours)
Examination of collegiate mathematics and science instruction with respect to goals and objectives, design of courses and curricula, innovative programs and facilities, and methods and materials for instruction.

Prerequisite: EMS 770, 621 or 622, Graduate standing
Typically offered in Spring only

EMS 704 Curriculum Development and Evaluation In Science and Mathematics (3 credit hours)
Critical study of elements of curriculum design and theory in mathematics education and science education and examination of evaluation procedures for assessing educational innovations.

Prerequisite: 500-level statistics, PSY 535
Typically offered in Spring only

EMS 705 Education and Supervision Of Teachers Of Mathematics and Science (3 credit hours)
Critical analysis of theories, programs and techniques designed to promote interpersonal interactions leading to more effective teaching of science and mathematics.

Prerequisite: EMS 770 or 621 or 622
Typically offered in Spring only

EMS 711 Research on the Teaching and Learning of Math at Secondary and Early College Levels (3 credit hours)
This course familiarizes students with theories and research related to mathematical thinking, learning and teaching at the secondary and early college levels with a focus on the following topics: function, expressions and equations, geometry, proof, limit, calculus, differential equations, and linear algebra. Students will apply theories to analyze secondary and freshmen/sophomore standing mathematical thinking, synthesize research findings, explain difficulties students experience, and design and conduct research. Restriction: at least 18 hrs of 400-500 level mathematics and a PhD student in Mathematics Education.

Typically offered in Spring only

EMS 712 Teaching Mathematics In Elementary and Junior High School (3 credit hours)
Comprehensive study of teaching mathematics in elementary and junior high schools. Major emphasis on building skills in teaching arithmetic, elementary algebra and intuitive geometry. Thorough search of literature relative to mathematics curricula conducted, designing and sequencing of learning activities, teaching mathematical concepts and relationships, building skill in computation, reading mathematics, problem solving and measurement.

Prerequisite: EMS 471
Typically offered in Spring and Summer

EMS 730 Trends and Issues in Science Education (3 credit hours)
Provides an in-depth examination and analysis of literature and research in science education as well as current trends in science education reform. Emphasis is placed on the analysis of theoretical models of inquiry. Course includes the development of a review of literature and the formation of research questions specific to science education.

Prerequisite: Graduate standing
Typically offered in Fall only

EMS 731 Fundamentals of Research in Science Education: Qualitative and Quantitative Inqu (3 credit hours)
Analyze the range of research designs currently utilized by science education reseachers. Develop an understanding of the assumptions and frameworks of different types of inquiry in science education. A brief history of research in science education is examined as a means to orient students to the trends that have taken place. Read, comprehend, and critically analyze qualitative and quantitative designs in science education.

Prerequisite: Graduate standing and ST 507 or 511, Corequisite: ST 508 or 512
Typically offered in Spring only

EMS 732 Theoretical and Critical Perspectives of Science Education (3 credit hours)
Examines current theoretical and critical perspectives of science education. Examines a variety of approaches which re-assess cultural notions of meaning, identity, power, and representation in the sciences and science education. Applies research theory to reform in science education.

Prerequisite: Graduate standing
Typically offered in Fall only

EMS 770 Foundations Of Mathematics Education (3 credit hours)
The current status of mathematics education with special emphasis on study and critical analysis of current practices in mathematics instruction from elementary school through college.

Prerequisite: EMS 471
Typically offered in Spring only

EMS 775 Foundations Of Science Education (3 credit hours)
Study and analysis of philosophical, historical, sociological, political and economic factors affecting science education in schools of the U.S. Implications for science education of various learning theories along with models for curriculum development and program planning. Critical analysis of current trends, issues and problems in science education in terms of multiple perspectives.

Prerequisite: EMS 475
Typically offered in Spring only

EMS 777 Improving Classroom Instruction In Science (3 credit hours)
Application of major principles of education and psychology to improvement of science teaching in elementary, middle and secondary schools. Emphasis on critical analysis of research and the development of research-based classroom applications. Goalsand objectives of science teaching, instructional strategies, development or selection of science materials, evaluation of achievement and elements of a desirable classroom climate.

Prerequisite: EMS 475
Typically offered in Spring only

EMS 780 Foundational Learning Theories in STEM Education (3 credit hours)
This course is an introduction to the field of learning sciences related to STEM education. Students examine the learning theories as they relate to STEM disciplines and apply the theories to the design of research. Applications of learning theory to STEM education reform will be discussed.

Restriction: Doctoral Standing in Learning and Teaching in STEM
Typically offered in Spring only

EMS 786/EAC 786 Teaching in College (3 credit hours)
Focus on development of competencies to perform fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and university responsibilities of a professor. In addition to attending lectures andother types of presentations, students make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching.

Typically offered in Fall and Summer

EMS 791 Contemporary Research and Critical Issues in STEM Education (3 credit hours)
This course is designed to provide disciplinary and interdisciplinary overviews of STEM issues and trends that will help graduate students construct their own theoretical foundations and practical understanding of STEM education. In the course, students will discuss a wide range of current issues, movements, and research-supported practices in STEM education not only in K-16 classrooms but also informal education settings. Students will also have opportunities to conceptualize their own framework for quality STEM education connecting research and practice in the field. A main course activity will be reading, analysis, and discussion of selected readings in each topic area. Students will share the responsibility of guiding class discussions, write up reflection and conceptualization, and conduct individual project that relates directly to the main topics explored in the course.

Prerequisites: Doctoral Standing in Learning and Teaching in STEM
Typically offered in Fall only

EMS 792 Special Problems in Math Teaching (3-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

Typically offered in Fall, Spring, and Summer

EMS 794 Special Problems in Science Teaching (3-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.

Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 802 Seminar In Mathematics Education (1-12 credit hours)
In-depth examination and analysis of literature and research in a particular topic(s) in mathematics education.

Prerequisite: Departmental Majors
Typically offered in Fall and Spring

EMS 803 Seminar In Science Education (2 credit hours)
In-depth examination and analysis of literature and research in a particular topic(s) in science education.

Prerequisite: Department Majors
Typically offered in Fall and Spring

EMS 821 Special Problems In Mathematics Teaching (1-6 credit hours)
In-depth investigation of topical problems in mathematics teaching chosen from areas of curriculum, methodology, technology, supervision and research.

Prerequisite: EMS 471
Typically offered in Summer only

EMS 822 Special Problems In Science Teaching (1-6 credit hours)
In-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class.

Prerequisite: EMS 476
Typically offered in Fall, Spring, and Summer

EMS 832 Research Applications in Science Education (3 credit hours)
Provides students with the opportunity to design science education research including formulating research questions, designing the methodologies to be used in the study, selecting assessments and protocols, and identifying appropriate analyses. Theoretical frameworks and associated assumptions are identified and critiqued. Develop advanced skills in reviewing different types of science education research and identifying issues of validity and reliability.

Prerequisite: EMS 730, EMS 731, ST 508
Typically offered in Spring only

EMS 841 Practicum In Science and Mathematics Education (1-6 credit hours)
Supervised practicum in appropriate settings both on- and off-campus. Provision for opportunity for development, implementation and evaluation in science and mathematics in clinical environment under faculty supervision.

Prerequisite: EMS 770 or EMS 775
Typically offered in Fall, Spring, and Summer

EMS 851 Internship In Mathematics and Science Education (1-9 credit hours)
Utilizing the participant-observer role, required participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. Student required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate consequences of selected course ofaction.

Prerequisite: Nine hrs. in grad. level courses
Typically offered in Fall, Spring, and Summer

EMS 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

EMS 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 892 Research Projects In Mathematics and Science Education (1-3 credit hours)
A project or problem in research in education for graduate students, supervised by members of the graduate faculty. The research chosen on basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 532
Typically offered in Fall, Spring, and Summer

EMS 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

EMS 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

EMS 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Math in Agriculture and Related Sciences (MAA)

MAA 102 Mathematics in Agriculture and Related Sciences (3 credit hours)
Develops the ability to utilize skills and technology to solve problems at a level found in non-mathematics-intensive programs. Topics include applications to percent, ratio and proportions, formulas, algebra and solutions to linear equations and the elements of plane geometry. Applications include, but are not limited to, business, finance and agriculture. Restricted to Agricultural Institute Students only. C-Wall course; Prerequisite for MA 103, Topics in Contemporary Math.

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

Mathematical Sciences (MSGE)

MSGE 295 Mathematical Sciences Special Topics (3 credit hours)
Special topics course offering for the general education Mathematical Sciences category.

GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

Mathematics (MA)

MA 101 Intermediate Algebra (4 credit hours)
Preparation for MA 103, MA 105, MA 107, MA 111, and MA 114. Reviews main topics from high school Algebra I and Algebra II emphasizing functions and problem solving. Other concepts and skills covered include algebraic operations, factoring, linear equations, graphs, exponents, radicals, complex numbers, quadratic equations, radical equations, inequalities, systems of equations, compound inequalities, absolute value in equations and inequalities. MA 101 may not be counted as credit toward meeting graduation. Credit for MA 101 is not allowed if student has prior credit in any other mathematical course.

Typically offered in Summer only

MA 103/MA 103A Topics in Contemporary Mathematics (3 credit hours)
Primarily for students in Humanities and Social Sciences. Illustrations of contemporary uses of mathematics, varying from semester to semester, frequently including sets and logic, counting procedures, probability, modular arithmetic, and game theory.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 103A/MA 103 Topics in Contemporary Mathematics (3 credit hours)
Primarily for students in Humanities and Social Sciences. Illustrations of contemporary uses of mathematics, varying from semester to semester, frequently including sets and logic, counting procedures, probability, modular arithmetic, and game theory.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall and Spring

MA 105 Mathematics of Finance (3 credit hours)
Simple and compound interest, annuities and their application to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance.

Prerequisite: MA 101 or equivalent completed in high school
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 107 Precalculus I (3 credit hours)
Algebra and basic trigonometry; polynomial, rational, exponential, logarithmic and trigonometric functions and their graphs. Credit for MA 107 does not count toward graduation for students in Engineering, College of Sciences, Bio and Ag Engineering (Science Program), Bio Sci (all options), Math Edu, Sci Edu, Textiles, and B.S. degrees in CHASS. Credit is not allowed for both MA 107 and MA 111

Prerequisite: C- or better in MA 101, or a 450 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 108 Precalculus II (3 credit hours)
Algebra, analytic geometry and trigonometry; inequalities, conic sections, complex numbers, sequences and series, solving triangles, polar coordinates, and applications.Credit for MA 108 does not count toward graduation for students in Engineering, College of Sciences, Design, Bio and Ag Engineering (Science Program), Bio Sci (all options), Math Edu, Sci Edu, Textiles, and B.S. degrees in CHASS. Credit is not allowed for both MA 108 and MA 111. Also, MA 108 should not be counted toward the GER mathematical sciences.

Prerequisite: C- or better in MA 107
Typically offered in Spring only

MA 111 Precalculus Algebra and Trigonometry (3 credit hours)
Real numbers, functions and their graphs (special attention to polynomial, rational, exponential, logarithmic, and trigonometric functions), analytic trigonometry. Credit in MA 111 does not count toward graduation for students in Engr., College of Sciences., Design, Biological & Ag. Engr. (Science Program), Biological Sci.(all options),Math. Edu., Forestry, & Textiles. Credit is not allowed for both MA 111 and either MA 107 or MA 108.

Prerequisite: C- or better in MA 101, or 480 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 114 Introduction to Finite Mathematics with Applications (3 credit hours)
Elementary matrix algebra including arithmetic operations, inverses, and systems of equations; introduction to linear programming including simplex method; sets and counting techniques, elementary probability including conditional probability; Markov chains; applications in the behavioral, managerial and biological sciences. Computer use for completion of assignments.

Prerequisite: MA 101 or equivalent completed in high school.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 116 Introduction to Scientific Programming (Math) (3 credit hours)
Computer-based mathematical problem solving and simulation techniques using MATLAB. Emphasizes scientific programming constructs that utilize good practices in code development, including documentation and style. Covers user-defined functions, data abstractions, data visualization and appropriate use of pre-defined functions. Applications are from science and engineering.

Prerequisite: MA 141, and either COS 100 or E 115; Corequisite: MA 241
Typically offered in Fall and Spring

MA 121 Elements of Calculus (3 credit hours)
For students who require only a single semester of calculus. Emphasis on concepts and applications of calculus, along with basic skills. Algebra review, functions, graphs, limits, derivatives, integrals, logarithmic and exponential functions, functions of several variables, applications in management, applications in biological and social sciences. Credit is not allowed in more than one of MA 121, 131, 141. MA 121 may not be substituted for MA 131 or MA 141 as a curricular requirement

Prerequisite: MA 107 or 111 with a C- or better, or 480 on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 121 and MA 131 or MA 141.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 131 Calculus for Life and Management Sciences A (3 credit hours)
First order finite difference models; derivatives - limits, power rule, graphing, and optimization; exponential and logarithmic functions - growth and decay models; integrals - computation, area, total change; applications in life, management, and social sciences. Credit not allowed for more than one of MA 121, 131, and 141

Prerequisite: C- or better in MA 107 or MA 111, or 520 or better on the SAT Subject Test in Mathematcs Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 131 and MA 121 or MA 141.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 132 Computational Mathematics for Life and Management Sciences (1 credit hours)
Computational aspects of calculus for the life and management sciences; use of spreadsheets and a computer algebra system; applications to data models, differential equation models, and optimization.

Prerequisite: C- or better in MA 121 or MA 131
Typically offered in Fall and Spring

MA 141 Calculus I (4 credit hours)
First of three semesters in a calculus sequence for science and engineering majors. Functions, graphs, limits, derivatives, rules of differentiation, definite integrals, fundamental theorem of calculus, applications of derivatives and integrals. Use of computation tools. Credit is not allowed for more than one of MA 141, 131, 121

Prerequisite: MA 111 or MA 108 with grade of C- or better, or 550 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 141 and MA 121 or MA 131.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 151 Calculus for Elementary Education I (3 credit hours)
Calculus for Elementary Education I is the first semester of a two semester sequence of courses designed for the Elementary Education Program. Topics will include sequences, limit, and derivative. Also, topics related to teaching elementary mathematics will be discussed. Students cannot receive credit for more than one of MA 151, MA 121, MA 131, or MA 141. MA 151 is not an accepted prerequisite for MA 231 and MA 241. This course is restricted to Elementary Education majors only.

Prerequisite: C- or better in MA 107 or MA 111, or 520 or better on the SAT Subject Test in Mathematcs Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam. Credit is not allowed for both MA 131 and MA 121 or MA 141.
GEP Mathematical Sciences
Typically offered in Spring only

MA 152 Calculus for Elementary Education II (3 credit hours)
Calculus for Elementary Education II is the second semester of a two semester sequence of courses designed for the Elementary Education Program. Topics will include derivative, integrals, difference equations, and differential equations. Also, topics related to teaching elementary mathematics will be discussed. This course is restricted to Elementary Education majors only. Students cannot receive credit for both MA 152 and MA 121, MA 131, or MA 141. MA 152 is not an accepted prerequisite for MA 241.

Prerequisite: MA 151
GEP Mathematical Sciences
Typically offered in Fall only

MA 225 Foundations of Advanced Mathematics (3 credit hours)
Introduction to mathematical proof with focus on properties of the real number system. Elementary symbolic logic, mathematical induction, algebra of sets, relations, functions, countability. Algebraic and completeness properties of the reals.

Prerequisite: MA 241
Typically offered in Fall, Spring, and Summer

MA 231 Calculus for Life and Management Sciences B (3 credit hours)
Functions of several variables - partial derivatives, optimization, least squares, Lagrange multiplier method; differential equations - population growth, finance and investment models, systems, numerical methods; MA 121 is not an accepted prerequisite for MA 231.

Prerequisite: MA 131 or MA 141; Credit is not allowed for both MA 231 and MA 241.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 241 Calculus II (4 credit hours)
Second of three semesters in a calculus sequence for science and engineering majors. Techniques and applications of integration, elementary differential equations, sequences, series, power series, and Taylor's Theorem. Use of computational tools.

Prerequisite: MA 141 with grade of C- or better or AP Calculus credit. Credit is not allowed for both MA 241 and MA 231.
GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

MA 242 Calculus III (4 credit hours)
Third of three semesters in a calculus sequence for science and engineering majors. Vectors, vector algebra, and vector functions. Functions of several variables, partial derivatives, gradients, directional derivatives, maxima and mimima. Multiple integration. Line and surface integrals, Green's Theorem, Divergence Theorems, Stokes' Theorem, and applications. Use of computational tools.

Prerequisite: MA 241 with grade of C- or better or AP Calculus credit, or Higher Level IB credit.
Typically offered in Fall, Spring, and Summer

MA 302 Numerical Applications to Differential Equations (1 credit hours)
Numerical methods for approximating solutions for differential equations, with an emphasis on Runge-Kutta-Fehlberg methods with stepsize control. Applications to population, economic, orbital and mechanical models.

Prerequisite: MA 241
Typically offered in Fall and Spring

MA 303 Linear Analysis (3 credit hours)
Linear difference equations of first and second order, compound interest and amortization. Matrices and systems of linear equations, eigenvalues, diagonalization, systems of difference and differential equations, transform methods, population problems. Credit not allowed if credit has been obtained for MA 341 or MA 405

Prerequisite: MA 241
Typically offered in Fall and Spring

MA 305 Introductory Linear Algebra and Matrices (3 credit hours)
The course is an elementary introduction to matrix theory and linear algebra. Emphasis is given to topics that will be useful in other disciplines, including systems of equations, Euclidean vector spaces, determinants, eigenvalues and eigenvectors, linear transformations, similarity, and applications such as numerical solutions of equations and computer graphics. Compares with MA 405 Introductory Linear Algebra, more emphasis is placed on methods and calculations,. Credit is not allowed for both MA 305 and MA 405.

Prerequisite: MA 241 or MA 231 with MA 132
Typically offered in Fall, Spring, and Summer

MA 315/MEA 315 Mathematics Methods in Atmospheric Sciences (4 credit hours)
For sophomore meteorology and marine science students. A complement to MA 242 designed to prepare students for quantitative atmospheric applications. Topics include an introduction to vectors and vector calculus, atmospheric waves, phase and group velocity, perturbation analysis, fourier decomposition, matrix operations, chaos and predictability. For MY, MMY, and MRM majors only.

Prerequisite: MEA 217 or MA 116 or CSC 113; Corequisite: MA 242
Typically offered in Spring only

MA 325 Introduction to Applied Mathematics (3 credit hours)
Introduces students with multivariable calculus to five different areas of applied mathematics. These areas will be five three-week modules, which lead to higher level courses in the application areas. Topics will vary, and examples of modules areheat and mass transfer, biology and population, probability and finance, acoustic models, cryptography as well as others.

Prerequisite: (MA 231 or MA 242) and (MA 116 or CSC 112 or CSC 114 or CSC 116)
Typically offered in Spring only

MA 331 Differential Equations for the Life Sciences (3 credit hours)
This course provides students with an understanding of how mathematics and life sciences can stimulate and enrich each other. The course topics include first order differential equations, separable equations, second order systems, vector and matrix systems, eigenvectors/ eigenvalues, graphical and qualitative methods. The methods are motivated with examples from the biological sciences (growth models, kinetics and compartmental models, epidemic models, predator-prey, etc). Computational modeling will be carried out using SimBiology, a MATLAB toolbox based graphical user interface, which which automates and simplifies the process of modeling biological systems. Credit cannot be given for both MA 341 and MA 331.

P: MA 231 or MA 241; X: Credit cannot be given for both MA 341 and MA 331
Typically offered in Fall only

MA 335/LOG 335 Symbolic Logic (3 credit hours)
Intermediate level introduction to modern symbolic logic focusing on standard first-order logic; topics include proofs, interpretations, applications and basic metalogical results.

Prerequisite: LOG 201 or MA 225 or CSC 226
GEP Mathematical Sciences
Typically offered in Fall only

MA 341 Applied Differential Equations I (3 credit hours)
Differential equations and systems of differential equations. Methods for solving ordinary differential equations including Laplace transforms, phase plane analysis, and numerical methods. Matrix techniques for systems of linear ordinary differential equations. Credit is not allowed for both MA 301 and MA 341

Prerequisite: MA 242 or (MA 132 and MA 231)
Typically offered in Fall, Spring, and Summer

MA 351 Introduction to Discrete Mathematical Models (3 credit hours)
Basic concepts of discrete mathematics, including graph theory, Markov chains, game theory, with emphasis on applications; problems and models from areas such as traffic flow, genetics, population growth, economics, and ecosystem analysis.

Prerequisite: MA 224, 225, 231 or 241
Typically offered in Fall only

MA 401 Applied Differential Equations II (3 credit hours)
Wave, heat and Laplace equations. Solutions by separation of variables and expansion in Fourier Series or other appropriate orthogonal sets. Sturm-Liouville problems. Introduction to methods for solving some classical partial differential equations.Use of power series as a tool in solving ordinary differential equations. Credit for both MA 401 and MA 501 will not be given

Prerequisite: MA 341; Credit not allowed for both MA 401 and MA 501
Typically offered in Fall, Spring, and Summer

MA 402 Mathematics of Scientific Computing (3 credit hours)
This course will provide an overview of methods to solve quantitative problems and analyze data. The tools to be introduced are mathematical in nature and have links to Algebra, Analysis, Geometry, Graph Theory, Probability and Topology. Students will acquire an appreciation of (I) the fundamental role played by mathematics in countless applications and (II) the exciting challenges in mathematical research that lie ahead in the analysis of large data and uncertainties. Students will work on a project for each unit. While this is not a programming class, the students will do some programming through their projects.

P: (MA 341 or MA 405) and programming proficiency (MATLAB, C++, Java, Fortran, or other language)
Typically offered in Fall and Spring

MA 403 Introduction to Modern Algebra (3 credit hours)
Sets and mappings, equivalence relations, rings, integral domains, ordered integral domains, ring of integers. Other topics selected from fields, polynomial rings, real and complex numbers, groups, permutation groups, ideals, and quotient rings. Credit is not allowed for both MA 403 and MA 407

Prerequisite: MA 225
Typically offered in Fall only

MA 405 Introduction to Linear Algebra (3 credit hours)
This course offers a rigorous treatment of linear algebra, including systems of linear equations, matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, eigenvalues and eigenvectors, similarity, inner product spaces, orthogonality and orthogonal bases, factorization of matrices. Compared with MA 305 Introductory Linear Algebra, more emphasis is placed on theory and proofs. MA 225 is recommended as a prerequisite. Credit is not allowed for both MA 305 and MA 405

Prerequisite: MA 241 (MA 225 recommended); Corequisite: MA 341 is recommended
Typically offered in Fall, Spring, and Summer

MA 407 Introduction to Modern Algebra for Mathematics Majors (3 credit hours)
Elementary number theory, equivalence relations, groups, homomorphisms, cosets, Cayley's Theorem, symmetric groups, rings, polynomial rings, quotient fields, principal ideal domains, Euclidean domains. Credit is not allowed for both MA 403 and MA 407

Prerequisite: MA 225 and MA 405
Typically offered in Fall and Spring

MA 408 Foundations of Euclidean Geometry (3 credit hours)
An examination of Euclidean geometry from a modern perspective. The axiomatic approach with alternative possibilities explored using models.

Prerequisite: MA 225
Typically offered in Fall and Spring

MA 410 Theory of Numbers (3 credit hours)
Arithmetic properties of integers. Congruences, arithmetic functions, diophantine equations. Other topics chosen from quadratic residues, the quadratic reciprocity Law of Gauss, primitive roots, and algebraic number fields.

Prerequisite: One year of calculus
Typically offered in Spring only

MA 412/ST 412 Long-Term Actuarial Models (3 credit hours)
Long-term probability models for risk management systems. Theory and applications of compound interest, probability distributions of failure time random variables, present value models of future contingent cash flows, applications to insurance, health care, credit risk, environmental risk, consumer behavior and warranties.

Prerequisite: MA 241 or MA 231, Corequisite: MA 421, BUS(ST) 350, ST 301, ST 305, ST 311, ST 361, ST 370, ST 371, ST 380 or equivalent
Typically offered in Fall and Summer

MA 413/ST 413 Short-Term Actuarial Models (3 credit hours)
Short-term probability models for risk management systems. Frequency distributions, loss distributions, the individual risk model, the collective risk model, stochastic process models of solvency requirements, applications to insurance and businessdecisions.

Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421.
Typically offered in Summer only

MA 414/MA 514/CSC 414/CSC 514 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.

Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

MA 416/CSC 416 Introduction to Combinatorics (3 credit hours)
Basic principles of counting: addition and multiplication principles, generating functions, recursive methods, inclusion-exclusion, pigeonhole principle; basic concepts of graph theory: graphs, digraphs, connectedness, trees; additional topics from:Polya theory of counting, Ramsey theory; combinatorial optimization - matching and covering, minimum spanning trees, minimum distance, maximum flow; sieves; mobius inversion; partitions; Gaussian numbers and q-analogues; bijections and involutions; partially ordered sets.

Prerequisite: Grade of C or better in either MA 225 or CSC 226
Typically offered in Spring only

MA 421 Introduction to Probability (3 credit hours)
Axioms of probability, conditional probability and independence, basic combinatorics, discrete and continuous random variables, joint densities and mass functions, expectation, central, limit theorem, simple stochastic processes.

Prerequisite: MA 242
Typically offered in Fall, Spring, and Summer

MA 425 Mathematical Analysis I (3 credit hours)
Real number system, functions and limits, topology on the real line, continuity, differential and integral calculus for functions of one variable. Infinite series, uniform convergence. Credit is not allowed for both MA 425 and MA 511.

Prerequisite: MA 225 (MA 407 desirable)
Typically offered in Fall and Spring

MA 426 Mathematical Analysis II (3 credit hours)
Calculus of several variables, topology in n-dimensions, limits, continuity, differentiability, implicit functions, integration. Credit is not allowed for both MA 426 and MA 512.

Prerequisite: MA 425 and 405
Typically offered in Fall and Spring

MA 427/CSC 427 Introduction to Numerical Analysis I (3 credit hours)
Theory and practice of computational procedures including approximation of functions by interpolating polynomials, numerical differentiation and integration, and solution of ordinary differential equations including both initial value and boundary value problems. Computer applications and techniques.

Prerequisite: (MA 341 or MA 301) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Fall only

MA 428/CSC 428 Introduction to Numerical Analysis II (3 credit hours)
Computational procedures including direct and iterative solution of linear and nonlinear equations, matrices and eigenvalue calculations, function approximation by least squares, smoothing functions, and minimax approximations.

Prerequisite: (MA 305 or MA 405) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or MA 116 or PY 251 or ST 114 or ECE 209)
Typically offered in Spring only

MA 430 Mathematical Models in the Physical Sciences (3 credit hours)
Application of mathematical techniques to topics in the physical sciences. Problems from such areas as conservative and dissipative dynamics, calculus of variations, control theory, and crystallography.

Prerequisite: MA 341 and MA 405
Typically offered in Fall only

MA 432 Mathematical Models in Life and Social Sciences (3 credit hours)
Topics from differential and difference equations, probability, and matrix algebra applied to formulation and analysis of mathematical models in biological and social science (e.g., population growth).

Prerequisite: MA 341, (MA 305 or MA 405), and programming proficiency; Corequisite: (MA 421 or ST 371)
Typically offered in Spring only

MA 437 Applications of Algebra (3 credit hours)
Error correcting codes, cryptography, crystallography, enumeration techniques, exact solutions of linear equations, and block designs.

Prerequisite: MA 403 or 407, MA 405
Typically offered in Fall and Spring

MA 444 Problem Solving Strategies for Competitions (1 credit hours)
Analyze the most common problem-solving techniques and illustrate their use by interesting examples from past Putnam and Virginia Tech math competitions. Problem solving methods are divided into groups and taught by professors of the math department. After the lecture, students practice writing the solutions for the assignment and have informal discussions in the next class.

Typically offered in Fall only

MA 450 Methods of Applied Mathematics I (3 credit hours)
Mathematical methods covered include dimensional analysis, asymptotics, continuum modeling and traffic flow analysis. These topics are discussed in the context of applications and real data. This course is independent of MA 451 Methods of Applied Mathematics II.

Prerequisite: MA 341
Typically offered in Fall only

MA 451 Methods of Applied Mathematics II (3 credit hours)
The mathematical methods of this course give insight into physical continuum processes such as fluid flow and the deformation of solid elastic materials. Techniques include the modeling and formulation of equations of motion, the use of Lagrangian and Eulerian variables; further topics are: examples of incompressible fluid flow, calculus of variations and applications to optimal control problems. This course is independent of MA 450 Methods of Applied Mathematics I.

Prerequisite: MA 341
Typically offered in Spring only

MA 491 Reading in Honors Mathematics (1-6 credit hours)
A reading (independent study) course available as an elective for students participating in the mathematics honors program.

Prerequisite: Membership in honors program
Typically offered in Fall and Spring

MA 493 Special Topics in Mathematics (1-6 credit hours)
Directed individual study or experimental course offerings.

Typically offered in Fall and Spring

MA 494 Major Paper in Math (1 credit hours)
Introduces students to one or more forms of writing used in scientific and research environments. Students are required to take a companion math course at the 400-level or above, and adapt writing assignment(s) to the topics in the companion course.Instruction covers all phases of the writing process (planning, drafting, revising, and critiquing other people's work). Emphasis is placed on organizing for needs of a variety of readers; concise, clear expression.

Corequisite: MA class at the 400-level or above
Typically offered in Fall and Spring

MA 499 Independent Research in Mathematics (1-6 credit hours)
Study and research in mathematics. Topics for theoretical, modeling or computational investigation. Consent of Department Head. Honors Program should enroll in MA 491H. At most 6 hours total of MA 499 and 491H credit can be applied towards an undergraduate degree. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

MA 501 Advanced Mathematics for Engineers and Scientists I (3 credit hours)
Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of variables; special functions, Fourier series. Applications to engineering and science. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics. Credit for this course and MA 401 is not allowed.

Prerequisite: MA 341; credit not allowed for both MA 501 and MA 401
Typically offered in Fall, Spring, and Summer

MA 502 Advanced Mathematics for Engineers and Scientists II (3 credit hours)
Determinants and matrices; line and surface integrals, integral theorems; complex integrals and residues; distribution functions of probability. Not for credit by mathematics majors. Any student receiving credit for MA 502 may receive credit for, atmost, one of the following: MA 405, MA 512, MA 513

Prerequisite: MA 341.
Typically offered in Fall, Spring, and Summer

MA 504/OR 504 Introduction to Mathematical Programming (3 credit hours)
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.

Prerequisite: MA 242, MA 405
Typically offered in Fall only

MA 505/OR 505/ISE 505 Linear Programming (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.

Prerequisite: MA 405
Typically offered in Fall only

MA 507 Survey of Real Analysis (3 credit hours)
A broad overview of topics in analysis. Historical development, logical refinement and applications of concepts such as limits, continuity, differentiation and integration. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MA 508 Survey of Geometry (3 credit hours)
A broad overview of topics in geometry. Various approaches to study of geometry, including vector geometry, transformational geometry and axiomatics. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MA 509 Survey of Abstract Algebra (3 credit hours)
A broad overview of topics in abstract algebra. Theory of equations, polynomial rings, rational functions and elementary number theory. May not be taken for graduate credit by Master's or Ph.D. students in Mathematics or Applied Mathematics.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

MA 510 Selected Topics In Mathematics For Secondary Teachers (1-6 credit hours)
Coverage of various topics in mathematics of concern to secondary teachers. Topics selected from areas such as mathematics of finance, probability, statistics, linear programming and theory of games, intuitive topology, recreational math, computers and applications of mathematics. Course may be taken for graduate credit for certification renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

Prerequisite: Graduate standing
Typically offered in Spring and Summer

MA 511 Advanced Calculus I (3 credit hours)
Fundamental theorems on continuous functions; convergence theory of sequences, series and integrals; the Riemann integral. Credit for both MA 425 and MA 511 is not allowed

Prerequisite: MA 341
Typically offered in Fall and Spring

MA 513 Introduction To Complex Variables (3 credit hours)
Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

Prerequisite: MA 242
Typically offered in Fall and Spring

MA 514/CSC 414/CSC 514/MA 414 Foundations of Cryptography (3 credit hours)
Cryptography is the study of mathematical techniques for securing digital information, systems and distributed computation against adversarial attacks. In this class you will learn the concepts and the algorithms behind the most used cryptographic protocols: you will learn how to formally define security properties and how to formally prove/disprove that a cryptographic protocol achieves a certain security property. You will also discover that cryptography has a much broader range of applications. It solves absolutely paradoxical problems such as proving knowledge of a secret without ever revealing the secret (zero-knowledge proof), or computing the output of a function without ever knowing the input of the function (secure computation). Finally, we will look closely at one of the recent popular application of cryptography: the blockchain technology. Additionally, graduate students will study some of the topics in greater depth.

Prerequisite: (CSC 226 AND CSC 333) OR MA 225
Typically offered in Fall only

MA 515 Analysis I (3 credit hours)
Metric spaces: contraction mapping principle, Tietze extension theorem, Ascoli-Arzela lemma, Baire category theorem, Stone-Weierstrass theorem, LP spaces. Banach spaces: linear operators, Hahn-Banach theorem, open mapping and closed graph theorems. Hilbert spaces: projection theorem, Riesz representation theorem, Lax-Milgram theorem, complete orthonormal sets.

Prerequisite: MA 426
Typically offered in Fall and Spring

MA 518 Geometry of Curves and Surfaces (3 credit hours)
Geometry of curves and surfaces in space; Arclength, torsion, and curvature of curves; Tangent spaces, shape operators, and curvatures of surfaces; metrics, covariant derivatives, geodesics, and holonomy. Applications in the physical sciences and/or projects using computer algebra.

Prerequisite: MA 242 and MA 405
Typically offered in Spring only

MA 520 Linear Algebra (3 credit hours)
Vector spaces. Bases and dimension. Changes of basis. Linear transformations and their matrices. Linear functionals. Simultaneous triangularization and diagonalization. Rational and Jordan canonical forms. Bilinear forms.

Prerequisite: MA 405
Typically offered in Fall and Spring

MA 521 Abstract Algebra I (3 credit hours)
Groups, quotient groups, group actions, Sylow's Theorems. Rings, ideals and quotient rings, factorization, principal ideal domains. Fields, field extensions, Galois theory.

Prerequisite: MA 405 and MA 407
Typically offered in Fall only

MA 522 Computer Algebra (3 credit hours)
Basic techniques and algorithms of computer algebra. Integer arithmetic, primality tests and factorization of integers, polynomial arithmetic, polynomial factorization, Groebner bases, integration in finite terms.

Prerequisite: MA 405 and MA 407
Typically offered in Fall only

MA 523 Linear Transformations and Matrix Theory (3 credit hours)
Vector spaces, linear transformations and matrices, orthogonality, orthogonal transformations with emphasis on rotations and reflections, matrix norms, projectors, least squares, generalized inverses, definite matrices, singular values.

Prerequisite: MA 405
Typically offered in Fall and Spring

MA 524 Combinatorics I (3 credit hours)
Enumerative combinatorics, including placements of balls in bins, the twelvefold way, inclusion/exclusion, sign-reversing involutions and lattice path enumeration. Partically ordered sets, lattices, distributive lattices, Moebius functions, and rational generating functions.

Prerequisite: MA 405 and MA 407
Typically offered in Fall only

MA 528/ECG 528/FIM 528 Options and Derivatives Pricing (3 credit hours)
The course covers (i) structure and operation of derivative markets, (ii) valuation of derivatives, (iii) hedging of derivatives, and (iv) applications of derivatives in areas of risk management and financial engineering. Models and pricing techniques include Black-Scholes model, binomial trees, Monte-Carlo simulation. Specific topics include simple no-arbitrage pricing relations for futures/forward contracts; put-call parity relationship; delta, gamma, and vega hedging; implied volatility and statistical properties; dynamic hedging strategies; interest-rate risk, pricing of fixed-income product; credit risk, pricing of defaultable securities.

Prerequisites: MA 341 and MA 405 and MA 421
Typically offered in Fall only

MA 531/E 531/OR 531 Dynamic Systems and Multivariable Control I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems.

Prerequisite: MA 341, MA 405
Typically offered in Fall only

MA 532 Ordinary Differential Equations I (3 credit hours)
Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, nonlinear systems, plane autonomous systems, stability theory.

Prerequisite: MA 341, 405, 425 or 511, Corequisite: MA 426 or 512
Typically offered in Fall only

MA 534 Introduction To Partial Differential Equations (3 credit hours)
Linear first order equations, method of characteristics. Classification of second order equations. Solution techniques for the heat equation, wave equation and Laplace's equation. Maximum principles. Green's functions and fundamental solutions.

Prerequisite: MA 425 or MA 511, MA 341, Corequisite: MA 426 or 512
Typically offered in Fall only

MA 537 Nonlinear Dynamics and Chaos (3 credit hours)
Usage of computer experiments for demonstration of nonlinear dynamics and chaos and motivation of mathematical definitions and concepts. Examples from finance and ecology as well as traditional science and engineering. Difference equations and iteration of functions as nonlinear dynamical systems. Fixed points, periodic points and general orbits. Bifurcations and transition to chaos. Symbolic dynamics, chaos, Sarkovskii's Theorem, Schwarzian derivative, Newton's method and fractals.

Prerequisite: MA 341 and MA 405
Typically offered in Spring only

MA 540 Uncertainty Quantification for Physical and Biological Models (3 credit hours)
Introduction to uncertainty quantification for physical and biological models. Parameter selection techniques, Bayesian model calibration, propagation of uncertainties, surrogate model construction, local and global sensitivity analysis.

Prerequisite: MA 341 and basic knowledge of probability, linear algebra, and scientific computation
Typically offered in Fall and Spring

MA 542 Convex Optimization Methods in Data Science (3 credit hours)
Convex optimization methods and their applications in various areas of data science including, but not limited to, signal and image processing, inverse problems, statistical data analysis, machine learning and classification. Basic theory, algorithm design and concrete applications.

Prerequisite: MA 141, 241, 242, or equivalent and MA 405 or equivalent; Some notions of elementary convex analysis are an asset but are neither required nor assumed known.
Typically offered in Fall only

MA 544 Computer Experiments In Mathematical Probability (3 credit hours)
Exposure of student to practice of performing mathematical experiments on computer, with emphasis on probability. Programming in an interactive language such as APL, MATLAB or Mathematica. Mathematical treatment of random number generation and application of these tools to mathematical topics in Monte Carlo method, limit theorems and stochastic processes for purpose of gaining mathematical insight.

Prerequisite: MA 421
Typically offered in Spring only

MA 546/ST 546 Probability and Stochastic Processes I (3 credit hours)
Modern introduction to Probability Theory and Stochastic Processes. The choice of material is motivated by applications to problems such as queueing networks, filtering and financial mathematics. Topics include: review of discrete probability and continuous random variables, random walks, markov chains, martingales, stopping times, erodicity, conditional expectations, continuous-time Markov chains, laws of large numbers, central limit theorem and large deviations.

Prerequisite: MA 421 and MA 425 or MA 511
Typically offered in Fall only

MA 547/FIM 547 Stochastic Calculus for Finance (3 credit hours)
This course explores stochastics calculus with its applications in pricing and hedging problems for financial derivatives such as options. Topics to be covered in the course include 1) discrete and continuous martingales, 2) Brownian motions and Ito's stochastic calculus, and 3) Black-Scholas framework for financial derivatives pricing and hedging.

Prerequisite: FIM 528 and MA(ST) 546
Typically offered in Spring only

MA 548/FIM 548 Monte Carlo Methods for Financial Math (3 credit hours)
Monte Carlo (MC) methods for accurate option pricing, hedging and risk management. Modeling using stochastic asset models (e.g. geometric Brownian motion) and parameter estimation. Stochastic models, including use of random number generators, random paths and discretization methods (e.g. Euler-Maruyama method), and variance reduction. Implementation using Matlab. Incorporation of the latest developments regarding MC methods and their uses in Finance.

Prerequisites: (MA 421 or ST 421), MA 341, and MA 405
Typically offered in Spring only

MA 549/FIM 549 Financial Risk Analysis (3 credit hours)
This course focuses on mathematical methods to analyze and manage risks associated with financial derivatives. Topics covered include aggregate loss distributions, extreme value theory, default probabilities, Value-at-Risk and expected shortfall, coherent risk measures, correlation and copula, applications of principle component analysis and Monte Carlo simulations in financial risk management, how to use stochastic differential equations to price financial risk derivatives, and how to back-test and stress-test models.

Prerequisites: MA 405 and (MA 421 or ST 421) and (MA/ST 412 or MA/ST 413)
Typically offered in Spring only

MA 551 Introduction to Topology (3 credit hours)
Set theory, topological spaces, metric spaces, continuous functions, separation, cardinality properties, product and quotient topologies, compactness, connectedness.

Prerequisite: MA 426
Typically offered in Fall only

MA 555 Introduction to Manifold Theory (3 credit hours)
An introduction to smooth manifolds. Topics include: topological and smooth manifolds, smooth maps and differentials, vector fields and flows, Lie derivatives, vector bundles, tensors, differential forms, exterior calculus, and integration on manifolds.

Prerequisite: MA 405 and MA 426
Typically offered in Fall only

MA 561 Set Theory and Foundations Of Mathematics (3 credit hours)
Logic and axiomatic approach, the Zermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalents of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, the Continuum Hypothesis.

Prerequisite: MA 407
Typically offered in Spring only

MA 565/OR 565/CSC 565 Graph Theory (3 credit hours)
Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matchings and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.

Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

MA 573/BMA 573 Mathematical Modeling of Physical and Biological Processes I (3 credit hours)
Introduction to model development for physical and biological applications. Mathematical and statistical aspects of parameter estimation. Compartmental analysis and conservation laws, heat transfer, and population and disease models. Analytic and numerical solution techniques and experimental validation of models. Knowledge of high-level programming languages required.

Prerequisite: MA 341 and knowledge of high-level programming language.
Typically offered in Fall only

MA 574/BMA 574 Mathematical Modeling of Physical and Biological Processes II (3 credit hours)
Model development, using Newtonian and Hamiltonian principles, for acoustic and fluid applications, and structural systems including membranes, rods, beams, and shells. Fundamental aspects of electromagnetic theory. Analytic and numerical solution techniques and experimental validation of models.

Prerequisite: MA/BMA 573
Typically offered in Spring only

MA 580/CSC 580 Numerical Analysis I (3 credit hours)
Algorithm behavior and applicability. Effect of roundoff errors, systems of linear equations and direct methods, least squares via Givens and Householder transformations, stationary and Krylov iterative methods, the conjugate gradient and GMRES methods, convergence of method.

Prerequisite: MA 405; MA 425 or MA 511; high-level computer language
Typically offered in Fall and Spring

MA 583/CSC 583 Introduction to Parallel Computing (3 credit hours)
Introduction to basic parallel architectures, algorithms and programming paradigms; message passing collectives and communicators; parallel matrix products, domain decomposition with direct and iterative methods for linear systems; analysis of efficiency, complexity and errors; applications such as 2D heat and mass transfer.

Prerequisite: CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580
Typically offered in Spring only

MA 584 Numerical Solution of Partial Differential Equations--Finite Difference Methods (3 credit hours)
Survey of finite difference methods for partial differential equations including elliptic, parabolic and hyperbolic PDE's. Consideration of both linear and nonlinear problems. Theoretical foundations described; however, emphasis on algorithm design and implementation.

Prerequisite: MA 501; knowledge of a high level programming language
Typically offered in Fall only

MA 587 Numerical Solution of Partial Differential Equations--Finite Element Method (3 credit hours)
Introduction to finite element method. Applications to both linear and nonlinear elliptic and parabolic partial differential equations. Theoretical foundations described; however, emphasis on algorithm design and implementation.

Prerequisite: MA 501; knowledge of a high level programming language
Typically offered in Spring only

MA 591 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

MA 601 Seminar (1 credit hours)
Review and discussion of scientific articles, progress reports on research and special problems of interest to mathematicians.

P: Graduate Standing
Typically offered in Fall and Spring

MA 676 Master's Project (3 credit hours)
Investigation of some topic in mathematics to a deeper and broader extent than typically done in a classroom situation. For the applied mathematics student the topic usually consists of a realistic application of mathematics to student's minor area.A written and oral report on the project required.

Typically offered in Fall, Spring, and Summer

MA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

MA 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MA 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

MA 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MA 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall and Spring

MA 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MA 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MA 706/OR 706/ST 706 Nonlinear Programming (3 credit hours)
An advanced mathematical treatment of analytical and algorithmic aspects of finite dimensional nonlinear programming. Including an examination of structure and effectiveness of computational methods for unconstrained and constrained minimization. Special attention directed toward current research and recent developments in the field.

Prerequisite: OR(IE,MA) 505 and MA 425
Typically offered in Spring only

MA 708/OR 708/ISE 708 Integer Programming (3 credit hours)
General integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. Students have some "hands on" computing experience that should enable them to adapt ideas presented in course to integer programming problems they may encounter.

Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112)
Typically offered in Spring only

MA 715 Analysis II (3 credit hours)
Integration: Legesgue measure and integration, Lebesgue-dominated convergence and monotone convergence theorems, Fubini's theorem, extension of the fundamental theorem of calculus. Banach spaces: Lp spaces, weak convergence, adjoint operators, compact linear operators, Fredholm-Fiesz Schauder theory and spectral theorem.

Prerequisite: MA 515
Typically offered in Spring only

MA 716 Advanced Functional Analysis (3 credit hours)
Advanced topics in functional analysis such as linear topological spaces; Banach algebra, spectral theory and abstract measure theory and integration.

Prerequisite: MA 715
Typically offered in Fall only

MA 719/OR 719 Vector Space Methods in System Optimization (3 credit hours)
Introduction to algebraic and function-analytic concepts used in system modeling and optimization: vector space, linear mappings, spectral decomposition, adjoints, orthogonal projection, quality, fixed points and differentials. Emphasis on geometricinsight. Topics include least square optimization of linear systems, minimum norm problems in Banach space, linearization in Hilbert space, iterative solution of system equations and optimization problems. Broad range of applications in operations research and system engineering including control theory, mathematical programming, econometrics, statistical estimation, circuit theory and numerical analysis.

Prerequisite: MA 405, 511
Typically offered in Fall only

MA 720 Lie Algebras (3 credit hours)
Definition of Lie algebras and examples. Nilpotent, solvable and semisimple Lie algebras. Engel's theorem, Lie's Theorem, Killing form and Cartan's criterion. Weyl's theorem on complete reducibility. Representations of s1(2,C). Root space decomposition of semisimple Lie algebras. Root system and Weyl group.

Prerequisite: MA 520
Typically offered in Spring only

MA 721 Abstract Algebra II (3 credit hours)
This course covers: Module theory including the structure theory of modules over a PID and primary decomposition; Tensor, exterior, and symmetric algebras; introductory homological algebra including: complexes, derived functors, Ext and Tor; and the representation theory of groups. Further topics will be covered as time permits.

Prerequisite: MA 521
Typically offered in Spring only

MA 722 Computer Algebra II (3 credit hours)
Effective algorithms for symbolic matrices, commutative algebra, real and complex algebraic geometry, and differential and difference equations. The emphasis is on the algorithmic aspects.

Prerequisite: MA 522
Typically offered in Spring only

MA 723 Theory of Matrices and Applications (3 credit hours)
Canonical forms, functions of matrices, variational methods, perturbation theory, numerical methods, nonnegative matrices, applications to differential equations, Markov chains.

Prerequisite: MA 520 or 523
Typically offered in Spring only

MA 724 Combinatorics II (3 credit hours)
Polytopes(V-polytopes and H-polytopes). Fourier-Motzkin elimination, Farkas Lemma, face numbers of polytopes, graphs of polytopes, linear programming for geometers, Balinski's Theorem, Steinitz' Theorem, Schlegel diagrams, polyhedral complexes, shellability, and face rings.

Prerequisite: MA 524
Typically offered in Spring only

MA 725 Lie Algebra Representation Theory (3 credit hours)
Semisimple Lie algebras, root systems, Weyl groups, Cartan matrices and Dynkin diagrams, universal enveloping algebras, Serre's Theorem, Kac-Moody algebras, highest weight representations of finite dimensional semisimple algebras and affine Lie algebras, Kac-Weyl character formula.

Prerequisite: MA 720
Typically offered in Fall only

MA 726 Algebraic Geometry (3 credit hours)
Abstract theory of solutions of systems of polynomial equations. Topics covered: ideals and affine varieties, the Nullstellensatz, irreducible varieties and primary decomposition, morphisms and rational maps, computational aspects including Groebner bases and elimination theory, projective varieties and homogeneous ideals, Grassmannians, graded modules, the Hilbert function, Bezout's theorem.

Prerequisite: MA 521
Typically offered in Spring only

MA 731/OR 731/E 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Stability of equilibrium points for nonlinear systems. Liapunov functions. Unconstrained and constrained optimal control problems. Pontryagin's maximum principle and dynamic programming. Computation with gradient methods and Newton methods. Multidisciplinary applications.

Prerequisite: OR(E,MA) 531
Typically offered in Spring only

MA 732 Ordinary Differential Equations II (3 credit hours)
Existence-uniqueness theory, periodic solutions, invariant manifolds, bifurcations, Fredholm's alternative.

Prerequisite: MA 532, Corequisite: MA 515
Typically offered in Spring only

MA 734 Partial Differential Equations (3 credit hours)
Linear second order parabolic, elliptic and hyperbolic equations. Initial value problems and boundary value problems. Iterative and variational methods. Existence, uniqueness and regularity. Nonlinear equations and systems.

Prerequisite: MA 534, Corequisite: MA 515
Typically offered in Spring only

MA 746/ST 746 Introduction To Stochastic Processes (3 credit hours)
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.

Prerequisite: MA 405 and MA(ST) 546 or ST 521
Typically offered in Spring only

MA 747/ST 747 Probability and Stochastic Processes II (3 credit hours)
Fundamental mathematical results of probabilistic measure theory needed for advanced applications in stochastic processes. Probability measures, sigma-algebras, random variables, Lebesgue integration, expectation and conditional expectations w.r.t.sigma algebras, characteristic functions, notions of convergence of sequences of random variables, weak convergence of measures, Gaussian systems, Poisson processes, mixing properties, discrete-time martingales, continuous-time markov chains.

Prerequisite: MA(ST) 546
Typically offered in Spring only

MA 748/ST 748 Stochastic Differential Equations (3 credit hours)
Theory of stochastic differential equations driven by Brownian motions. Current techniques in filtering and financial mathematics. Construction and properties of Brownian motion, wiener measure, Ito's integrals, martingale representation theorem, stochastic differential equations and diffusion processes, Girsanov's theorem, relation to partial differential equations, the Feynman-Kac formula.

Prerequisite: MA(ST) 747
Typically offered in Fall only

MA 753 Algebraic Topology (3 credit hours)
Homotopy, fundamental group, covering spaces, classification of surfaces, homology and cohomology.

Prerequisite: MA 551 or MA 555
Typically offered in Spring only

MA 755 Introduction to Riemannian Geometry (3 credit hours)
An introduction to smooth manifolds with metric. Topics include: Riemannian metric and generalizations, connections, covariant derivatives, parallel translation, Riemannian (or Levi-Civita) connection, geodesics and distance, curvature tensor, Bianchi identities, Ricci and scalar curvatures, isometric embeddings, Riemannian submanifolds, hypersurfaces, Gauss Bonnet Theorem; applications and connections to other fields.

Prerequisite: MA 555
Typically offered in Spring only

MA 766/OR 766/ISE 766 Network Flows (3 credit hours)
Study of problems of flows in networks. These problems include the determination of shortest chain, maximal flow and minimal cost flow in networks. Relationship between network flows and linear programming developed as well as problems with nonlinear cost functions, multi-commodity flows and problem of network synthesis.

Prerequisite: OR(IE,MA) 505
Typically offered in Spring only

MA 771/ST 771/BMA 771 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories oftwo and more species systems (predator-prey, competition, symbosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structureof models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.

Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only

MA 772/ST 772/BMA 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.

Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only

MA 773/OR 773/ST 773/BMA 773 Stochastic Modeling (3 credit hours)
Survey of modeling approaches and analysis methods for data from continuous state random processes. Emphasis on differential and difference equations with noisy input. Doob-Meyer decomposition of process into its signal and noise components. Examples from biological and physical sciences, and engineering. Student project.

Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

MA 774/BMA 774/OR 774 Partial Differential Equation Modeling in Biology (3 credit hours)
Modeling with and analysis of partial differential equations as applied to real problems in biology. Review of diffusion and conservation laws. Waves and pattern formation. Chemotaxis and other forms of cell and organism movement. Introduction to solid and fluid mechanics/dynamics. Introductory numerical methods. Scaling. Perturbations, Asymptotics, Cartesian, polar and spherical geometries. Case studies.

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501
Typically offered in Spring only

MA 780/CSC 780 Numerical Analysis II (3 credit hours)
Approximation and interpolation, Fast Fourier Transform, numerical differentiation and integration, numerical solution of initial value problems for ordinary differential equations.

Prerequisite: MA 580
Typically offered in Spring only

MA 784 Nonlinear Equations and Unconstrained Optimization (3 credit hours)
Newton's method and Quasi-Newton methods for nonlinear equations and optimization problems, globally convergent extensions, methods for sparse problems, applications to differential equations, integral equations and general minimization problems. Methods appropriate for boundary value problems.

Prerequisite: MA 580
Typically offered in Spring only

MA 788 Numerical Nonlinear Partial Differential Equations (3 credit hours)
Nonlinear discrete equations; Newton and monotone methods for nonlinear equations; computational algorithms and applications; finite difference method-convergence, stability and error estimates; multiplicity of solutions and bifurcation; asymptotic behavior of solutions; and coupled systems of equations.

Prerequisite: MA 405 or 520 and MA 501 or 534; knowledge of a high level programming language
Typically offered in Spring only

MA 791 Special Topics In Real Analysis (1-6 credit hours)
Typically offered in Fall and Spring

MA 792 Special Topics In Algebra (1-6 credit hours)
Typically offered in Fall and Spring

MA 793 Special Topics In Differential Equations (1-6 credit hours)

MA 796 Special Topics In Combinatorial Analysis (1-6 credit hours)

MA 797 Special Topics In Applied Mathematics (1-6 credit hours)

MA 798 Special Topics In Numerical Analysis (1-6 credit hours)

MA 810 Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

MA 812/ISE 812 Special Topics in Mathematical Programming (1-6 credit hours)
Study of special advanced topics in area of mathematical programming. Discussion of new techniques and current research in this area. The faculty responsible for this course select areas to be covered during semester according to their preference and interest. This course not necessarily taught by an individual faculty member but can, on occasion, be joint effort of several faculty members from this university as well as visiting faculty from other institutions. To date, a course of Theory of Networks and another on Integer Programming offered under the umbrella of this course. Anticipation that these two topics will be repeated in future together with other topics.

Prerequisite: IE(MA,OR) 505
Typically offered in Spring only

MA 816/ISE 816 Advanced Special Topics Sys Opt (1-6 credit hours)
Advanced topics in some phase of system optimization. Identification of various specific topics and prerequisite for each section from term to term.

Typically offered in Fall and Spring

MA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MA 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MA 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MA 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MA 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MA 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Mechanical & Aerospace Engr (MAE)

MAE 200 Introduction to Mechanical Engineering Design (1 credit hours)
Introduction to mechanical engineering and its application in professional practice. Includes mechanical engineering vocabulary, measurement concepts, safety training, demonstration of basic machine components and systems, dissection of mechanical engineering devices, simple drawing and sketching, 3d printing, technical communication, design, creation of Online Portfolio. (5-week course)

Restriction: Sophomore standing in Mechanical Engineering
Typically offered in Fall only

MAE 201 Engineering Thermodynamics I (3 credit hours)
Introduction to the concept of energy and the laws governing the transfers and transformations of energy. Emphasis on thermodynamic properties and the First and Second Law analysis of systems and control volumes. Integration of these concepts into the analysis of basic power cycles is introduced.

Prerequisite: MA 242, PY 208 or 202
Typically offered in Fall, Spring, and Summer

MAE 206 Engineering Statics (3 credit hours)
Basic concepts of forces in equilibrium. Distributed forces, frictional forces. Inertial properties. Application to machines, structures, and systems. Credit is not allowed for both MAE 206 and CE 214.

Prerequisite: C or better in both MA 241 and PY 205
Typically offered in Fall, Spring, and Summer

MAE 208 Engineering Dynamics (3 credit hours)
Kinematics and kinetics of particles in rectangular, cylindrical, and curvilinear coordinate systems; energy and momentum methods for particles; kinetics of systems of particles; kinematics and kinetics of rigid bodies in two and three dimensions; motion relative to rotating coordinate systems.

Prerequisite: MA 242 and C- or better in MAE 206 or CE 214
Typically offered in Fall, Spring, and Summer

MAE 214 Solid Mechanics (3 credit hours)
Concepts and theories of internal force, stress, strain, and strength of structural element under static loading conditions. Constitutive behavior for linear elastic structures. Deflection and stress analysis procedures for bars, beams, and shafts.Introduction to matrix analysis of structures.

Prerequisites: MA 242 and C- or better in (MAE 206 or CE 214)
Typically offered in Fall, Spring, and Summer

MAE 250 Introduction to Aerospace Engineering (1 credit hours)
The objective of this course is to introduce students to the fundamental concepts associated with aerospace engineering. This will be done through lectures focused on fluid flow, structures, dynamics, and complex system design. Students will also engage in hands-on mini-projects that will provide a design experience. Final efforts will culminate in a design portfolio project. 14AE BS Majors only.

Typically offered in Fall only

MAE 251 Aerospace Vehicle Performance (3 credit hours)
Introduction to the problem of performance analysis in aerospace engineering. Aircraft performance in gliding, climbing, level, and turning flight. Calculation of vehicle take-off and landing distance, range and endurance. Elementary performance design problems. Introduction to space flight.

Prerequisite: Cumulative GPA 2.0 or higher and a grade of C or better in both MA 241 and PY 205; Corequisite: CSC 113
Typically offered in Fall only

MAE 252 Aerodynamics I (3 credit hours)
Fundamentals of perfect fluid theory with applications to incompressible flows over airfoils, wings, and flight vehicle configurations.

Prerequisites: MA 242 and C- or better in MAE 251
Typically offered in Spring only

MAE 253 Experimental Aerodynamics I (1 credit hours)
Subsonic wind tunnel, instrumentation, data acquisition techniques, technical report preparation. Experiments involve pressure and force/moment measurements of various aerospace vehicle components with supplemental flow visualization.

Corequisites: MAE 252
Typically offered in Spring only

MAE 302 Engineering Thermodynamics II (3 credit hours)
Continuation of Engineering Thermodynamics I with emphasis on the analysis of power and refrigeration cycles and the application of basic principles to engineering problems with systems involving mixtures of ideal gases, psychrometrics, nonideal gases, chemical reactions, combustion, chemical equilibrium cycle analysis, and one-dimensional compressible flow.

Prerequisites: CSC 113, C- or better in MAE 201
Typically offered in Fall, Spring, and Summer

MAE 305 Mechanical Engineering Laboratory I (1 credit hours)
Theory and practice of measurement and experimental data collection. Laboratory evaluation and demonstration of components of the generalized measurement system and their effects on the final result. Applications of basic methods of data analysis aswell as basic instrumentation for sensing, conditioning and displaying experimental qualities. (Instruction and practice in technical report writing.)

Typically offered in Fall, Spring, and Summer

MAE 306 Mechanical Engineering Laboratory II (1 credit hours)
Continuation of MAE 305 into specific types of measurements. Students evaluate and compare different types of instrumentation for measuring the same physical quantity on the basis of cost, time required, accuracy, etc. (Oral and written presentation of technical material).

Prerequisite: MAE 305
Typically offered in Fall, Spring, and Summer

MAE 308 Fluid Mechanics (3 credit hours)
Development of the basic equations of fluid mechanics in general and specialized form. Application to a variety of topics including fluid statics; inviscid, incompressible fluid flow; design of Fluid dynamic system.

Prerequisite: MA 242 and C- or better in MAE 208
Typically offered in Fall, Spring, and Summer

MAE 310 Heat Transfer Fundamentals (3 credit hours)
Analysis of steady state and transient one and multidimensional heat conduction employing both analytical methods and numerical techniques. Integration of principles and concepts of thermodynamics and fluid mechanics to the development of practicalconvective heat transfer relations relevant to mechanical engineers. Heat transfer by the mechanism of radiation heat transfer.

Prerequisite: MA 341 and C- or better in MAE 201
Typically offered in Fall, Spring, and Summer

MAE 315 Dynamics of Machines (3 credit hours)
Application of dynamics to the analysis and design of machine and mechanical components. Motions resulting from applied loads, and the forces required to produce specified motions. Introduction to mechanical vibration, free and forced response of discrete and continuous systems.

Prerequisite: MA 341 and C- or better in MAE 208
Typically offered in Fall, Spring, and Summer

MAE 316 Strength of Mechanical Components (3 credit hours)
Analysis and design of mechanical components based on deflection, material, static strength and fatigue requirements. Typical components include beams, shafts, pressure vessels and bolted and welded joints. Classical and modern analysis and design techniques. Computer analysis using the finite element method. Material and manufacturing considerations in design.

Prerequisite: C- or better in MAE 214 or CE 313
Typically offered in Fall, Spring, and Summer

MAE 342 Introduction to Automotive Engineering (3 credit hours)
Fundamental aspects of automotive engineering. Examines various automotive systems [engine, brakes, suspension etc.] as well as their interactions in such areas as safety and performance. Current practices and development for the future.

Prerequisite: MAE 206, MAE 208, MAE 201, MAE 308, MAE 315
Typically offered in Spring only

MAE 351 Aerodynamics II (3 credit hours)
Concepts of thermodynamics, compressible fluid flow, and shock waves with application to computing the aerodynamic characteristics of airfoils, wings and flight configurations at high speed.

Prerequisites: MAE 252 and C- or better in MAE 201
Typically offered in Spring only

MAE 352 Experimental Aerodynamics II (1 credit hours)
Advanced stability and control experiments in the subsonic wind tunnel and external compressible flow experiments in the supersonic wind tunnel.

Prerequisite: MAE 253, Corequisite: MAE 351
Typically offered in Spring only

MAE 361 Dynamics & Controls (3 credit hours)
Dynamics and linear feedback control of aerospace and mechanical systems. Concepts from linear system theory, kinematics, particle dynamics, first- and second-order systems, system dynamics, vibrations, and computational techniques. Feedback controlby root-locus, Nyquist, Bode plots, servo-mechanisms, gain and phase margin, and compensation. Control system design emphasized.

Prerequisite: MA 341 and C- or better in MAE 208
Typically offered in Fall only

MAE 371 Aerospace Structures I (3 credit hours)
Determination of appropriate analysis techniques for Aerospace Structures. Introduction of governing equations and selected solutions for typical structures. Use of these concepts in the design of a representative structural component.

Prerequisite: C- or better in MAE 214 or CE 313
Typically offered in Fall only

MAE 372 Aerospace Vehicle Structures Lab (1 credit hours)
Demonstration and application of the concepts that have been presented in MAE 371 and MAE 472. Fabrication techniques and the design and construction of a structural component will be emphasized.

Corequisite: MAE 371
Typically offered in Fall only

MAE 403 Air Conditioning (3 credit hours)
Design of a complete air conditioning system for a building. Introduction, Design Objectives - Building Description, Review of Psychrometrics and Air Conditioning Processes, Cooling and Heating Load Calculation, Space Air diffusion, Duct Lay-out and Design, Equipment Selection, Pipe Sizing, Life-cycle Cost Analysis.

Prerequisite: MAE 302, MAE 310, MAE 308
Typically offered in Spring only

MAE 405 Controls Lab (1 credit hours)
Laboratory experiments demonstrate the essential features of classical and modern control theory for single-input and single-output systems.

Corequisite: MAE 435
Typically offered in Fall, Spring, and Summer

MAE 406 Energy Conservation in Industry (3 credit hours)
Application of energy conservation principles to a broad range of industrial situations with emphasis on typical equipment encountered as well as the effect of recent environmental regulations. Topics covered include: steam generators, pollution control, work minimization, heat recovery, steam traps, industrial ventilation, electrical energy management, and economics. Field trip to conduct tests and evaluate operation at three NCSU steam plants.

Prerequisite: MAE 302, MAE 310
Typically offered in Fall only

MAE 407 Steam and Gas Turbines (3 credit hours)
Fundamental analysis of the theory and design of turbomachinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.

Prerequisite: MAE 302 and (MAE 308 or MAE 252)
Typically offered in Spring only

MAE 408 Internal Combustion Engine Fundamentals (3 credit hours)
Fundamentals common to internal combustion engine cycles of operation. Otto engine: carburetion, combustion, knock, exhaust emissions and engine characteristics. Diesel engine: fuel metering, combustion, knock, and performance. Conventional and alternative fuels used in internal combustion engines.

Prerequisite: MAE 302
Typically offered in Fall only

MAE 410 Modern Manufacturing Processes (3 credit hours)
Introduction to modern manufacturing processes and technologies. Topics to be covered include traditional machining, laser and electrochemical machining, electro-discharge machining, geometric dimensioning & tolerancing, tolerance chart, statistical process control, metal forming, metal casting, rapid prototyping, welding, micro-fabrication, hybrid processes, and computer aided manufacturing. To relate theory taught in class with practice, the course includes mini projects on machining, rapid prototyping, and material testing.

Prerequisite: MAE 316 or MAE 371
Typically offered in Fall only

MAE 412 Design of Thermal System (3 credit hours)
Applications of thermodynamics, fluid mechanics, and heat transfer to thermal systems with an emphasis on system design and optimization. Design of heat exchangers. Analysis of engineering economics, including time value of money, present and future worth, payback period, internal rates of return, and cost benefit analysis. Review of component model for pipes, pumps, fans, compressors, turbines, evaporators, condensers and refrigerators. Simulation methods for finding the operating point for thermal systems. Design of thermal systems through methods of optimization.

Prerequisite: MAE 302, MAE 308, MAE 310
Typically offered in Fall and Spring

MAE 413 Design of Mechanical Systems (3 credit hours)
Integration of the physical sciences, mathematics, and engineering to solve real-world mechanical engineering design problems. Design of mechanical elements including: fasteners, welds, springs, bearings, gears, belts, brakes, clutches, flywheels, shafts. Emphasis on open-ended problems which contain superfluous information and/or insufficient data. Solution techniques focus on problem definition,reduction to a solvable system, and development of a design response. Team based projects. Formal written communication of results.

Prerequisite: MAE 315 and MAE 316
Typically offered in Fall only

MAE 415 Mechanical Engineering Design I (3 credit hours)
The first course in the sequence of a two-semester capstone senior design project. Teamwork, independent learning and communication skills are emphasized. Team of students practice engineering design process through: problem definition, research, brainstorming, optimization, critical review and analysis. Lectures focus on conceptual design, embodiment design, and quality. Communication skills are developed through reports and presentations.

Prerequisite: MAE 315, MAE 316, MAE 302, MAE 308 and MAE 310
Typically offered in Fall only

MAE 416 Mechanical Engineering Design II (4 credit hours)
The second course in the sequence of a two-semester capstone senior design project. Teamwork, independent learning and communication skills are emphasized. Building on the experience and knowledge from Mechanical Engineering Design I, teams of students extend engineering design process through: investigation, critical review, analysis, and prototype construction and testing. Communication skills are developed through reports and presentations.

Prerequisite: MAE 415
Typically offered in Spring only

MAE 420/MAE 520 Dynamic Analysis of Human Movement (3 credit hours)
Topics in movement biomechanics and computational analyses of movement, including muscle physiology and mechanics, advanced muscle modeling, neural control of muscle and motor control theories, and dynamic simulation and optimization. Discussion of fundamental research underpinnings and clinical and sports applications.

P: MAE208 or equivalent
Typically offered in Spring only

MAE 421 Design of Solar Thermal Systems (3 credit hours)
Analysis and design of active and passive solar thermal systems for residential and small commercial buildings. Solar insulation, flat plate collectors, thermal storage, heat exchanges, controls, design, performance calculations, economics. Site evaluation, shading, suncharts, types of passive systems. Heating load analysis. Overview of photovoltaics. On-site evaluation of NCSU Solar House.

Prerequisite: MAE 302, MAE 310
Typically offered in Spring only

MAE 426/MAE 526 Fundamentals of Product Design (3 credit hours)
Many think of design as more of an art than a science. However, the growing body of research in the engineering design community teaches us ways to navigate the design of consumer products using interdisciplinary design tools and rational decision making. This course introduces students to scientific design techniques that are more effective than "ad hoc" tactics. By exploring how engineering principles integrate with "real world" design challenges, students will learn to solve product design problems that encompass heterogeneous markets, multiple disciplines, and large-scale complex systems.

Prerequisite: MA 241
Typically offered in Spring only

MAE 430 Applied Finite Element Analysis (3 credit hours)
Finite element modeling techniques for solving real-world engineering problems are discussed. Theory of finite element discretization is highlighted follow by software implementation, emphasis is given on accurate prescription of boundary conditions that represent actual physical systems, modeling exercises and projects include solid structural problems, heat transfer, structural vibrations, fluid dynamics and contact problems, modeling is carried out using commercial software packages.

Prerequisite: MAE 201 and (MAE 316 or MAE 371)
Typically offered in Spring only

MAE 435 Principles of Automatic Control (3 credit hours)
Study of linear feedback control systems using transfer functions. Transient and steady state responses. Stability and dynamic analyses using time response and frequency response techniques. Compensation methods. Classical control theory techniquesfor determination and modification of the dynamic response of a system. Synthesis and design applications to typical mechanical engineering control systems. Introduction to modern control theory.

Prerequisites: MAE 315 or MAE 361
Typically offered in Fall, Spring, and Summer

MAE 440 Non-Destructive Testing and Evaluation (3 credit hours)
NDT/NDE is a 3-credit elective course covering the general defect and damage types in materials and structures, principles of NDT/NDE techniques, and NDT/NDE applications. Associated lab modules (3 weeks) provide hands-on opportunities to students on often used NDT/NDE methods including magnetic particle, ultrasonics, and eddy current methods. A final project team will work on research and industrial NDT/NDE solutions.

Junior or Senior standing in the College of Engineering
Typically offered in Fall only

MAE 451 Experimental Aerodynamics III (1 credit hours)
Laboratory experiments in internal compressible flow and boundary layers in conjunction with MAE 458 or MAE 459. Topics include nozzle flows, constant area duct flows, component/overall performance of a gas turbine, and boundary layer analysis.

Prerequisite: MAE 352, Corequisite: MAE 458 or MAE 459
Typically offered in Fall only

MAE 452 Aerodynamics of V/STOL Vehicles (3 credit hours)
Introduction to the aerodynamics and performance of vertical and short take-off and landing vehicles. Aerodynamics of propellers and rotors. High lift devices.

Typically offered in Fall only

MAE 455 Boundary Layer Theory (3 credit hours)
Introduction to the Navier-Stokes Equations and boundary layer approximations for incompressible flow. Calculation techniques for laminar and turbulent boundary layer parameters which affect lift, drag, and heat transfer on aerospace vehicles. Discussions of compressible flows.

Prerequisite: MAE 252 or MAE 308
Typically offered in Fall only

MAE 456 Computational Methods in Aerodynamics (3 credit hours)
Introduction to computational methods for solving exact fluid equations. Emphasis on development of the fundamentals of finite difference methods and their application to viscous and inviscid flows.

Prerequisite: MAE 252
Typically offered in Spring only

MAE 457 Flight Vehicle Stability and Control (3 credit hours)
Longitudinal, directional and lateral static stability and control of aerospace vehicles. Lineralized dynamic analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through use of the transfer function concept. Control of static and dynamic behavior by vehicle design (stability derivatives) and/or flight control systems.

Prerequisite: MAE 252 and (MAE 361 or MAE 315)
Typically offered in Spring only

MAE 458 Propulsion (3 credit hours)
One-dimensional, internal, compressible flow including: isentropic flow, normal shocks, flow with friction and simple heat addition. Applications to air-breathing aircraft propulsion systems. Performance, analysis and design of components and overall performance of air-breathing engines.

Prerequisite: MAE 351
Typically offered in Fall only

MAE 459 Rocket Propulsion (3 credit hours)
Study of chemical rockets. This includes nozzle theory, flight performance, thermochemical calculations, and component and system analysis and design.

Prerequisite: MAE 351or MAE 302
Typically offered in Fall only

MAE 467 Introduction to Space Flight (3 credit hours)
Fundamental aspects of space flight including launch vehicle performance and design, spacecraft characteristics, two-body orbital mechanics, earth satellites, interplanetary trajectories, atmospheric entry, and atmospheric heating.

Prerequisites: MAE 361 or MAE 315
Typically offered in Spring only

MAE 470/MAE 570 Space Exploration Systems (3 credit hours)
This course will cover topics related to space exploration systems. In particular, the basic concepts of orbital mechanics needed for space mission planning will be covered, along with the essential subsystems found on a typical spacecraft.

Prerequisite: MAE 467 Introduction to Space Flight or Graduate Standing and Consent of Instructor
Typically offered in Fall only

MAE 472 Aerospace Structures II (3 credit hours)
A continuation of MAE 371; deflection of structures, indeterminate structures, minimum weight design fatigue analysis and use of matrix methods in structural analysis. Selection of materials for aircraft construction based on mechanical, physical, and chemical properties.

Prerequisite: MAE 371
Typically offered in Spring only

MAE 480 Aerospace Vehicle Design I (3 credit hours)
A synthesis of previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

Prerequisites: (MAE 457 or MAE 467) and MAE 252 and MAE 371; Restrictions: Senior standing and Aerospace Engineering Majors
Typically offered in Fall only

MAE 481 Aerospace Vehicle Design II (3 credit hours)
A continuation of MAE 480. Designs are refined and vehicles constructed and instrumented by students. A flight test program is designed and carried out in cooperation with MAE 525 students.

Prerequisite: MAE 480
Typically offered in Spring only

MAE 482/ECE 482 Engineering Entrepreneurship and New Product Development I (3 credit hours)
Applications of engineering, mathematics, basic sciences, finance, and business to the design and development of prototype engineering products. This course requires a complete written report and an end-of-course presentation. This is the first course in a two semester sequence. Students taking this course will implement their designed prototype in ECE 483: Senior Design Project in Electrical Engineering and Computer Engineering II-Engineering Entrepreneurs. Departmental approval required.

Typically offered in Fall only

MAE 483/ECE 483 Engineering Entrepreneurship and New Product Development II (3 credit hours)
Applications of engineering, science, management and entrepreneurship to the design, development and prototyping of new product ideas. Based on their own new product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as 'virtual' startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the university that agree to participate as eTeam members. Departmental approval required.

Prerequisite: ECE 482
Typically offered in Fall and Spring

MAE 484 Engineering Entrepreneurship Senior Design Lab (1 credit hours)
This is the lab for MAE 483. Applications of engineering, science, management, and entrepreneurship to the design, development, and prototyping of new product ideas. Based on their own product ideas, or those of others, students form and lead entrepreneurship teams (eTeams) to prototype these ideas. The students run their eTeams as 'virtual' startup companies where the seniors take on the executive roles. Joining them are students from other grade levels and disciplines throughout the University that agree to participate as eTeam members. Departmental approval required.

Prerequisite: MAE/ECE 482; C: MAE/ECE 483
Typically offered in Spring only

MAE 495 Special Topics in Mechanical and Aerospace Engineering (1-3 credit hours)
Offered as needed to present new or special MAE subject matter.

MAE 496 Undergraduate Project Work in Mechanical and Aerospace Engineering (1-6 credit hours)
Individual or small group project in engineering, comprising the design of an equipment or system stemming from a mutual student-faculty interest; a substantial final report (project) containing calculations, drawings and specifications must be produced. Alternatively, individual or small group undergraduate research evolving from a mutual student-faculty interest; a conference or scientific journal paper must be submitted for publication. Departmental approval required

Prerequisite: Completion of all required MAE-300 level courses, Corequisite: MAE 415 or MAE 478
Typically offered in Fall, Spring, and Summer

MAE 501 Advanced Engineering Thermodynamics (3 credit hours)
Classical thermodynamics of a general reactive system; conservation of energy and principles of increase of entropy; fundamental relation of thermodynamics; Legendre transformations; phase transitions and critical phenomena; equilibrium and stability criteria in different representation; irreversible thermodynamics. Introduction to statistical thermodynamics.

Prerequisite: MAE 302; MA 401 or MA 511
Typically offered in Spring only

MAE 504 Fluid Dynamics Of Combustion I (3 credit hours)
Gas-phase thermochemistry including chemical equilibrium and introductory chemical kinetics. Homogeneous reaction phenomena. Subsonic and supersonic combustion waves in premixed reactants (deflagration and detonation). Effects of turbulence. Introduction to diffusion flame theory.

Prerequisite: MAE 201 or MAE 252 or MAE 308
Typically offered in Fall only

MAE 505 Heat Transfer Theory and Applications (3 credit hours)
Development of basic equations for steady and transient heat and mass transfer processes. Emphasis on application of basic equations to engineering problems in areas of conduction, convection, mass transfer and thermal radiation.

Prerequisite: MAE 310
Typically offered in Fall only

MAE 508 Automotive Power Systems (3 credit hours)
This course will cover topics related to automotive power systems. In particular, this course provides fundamental concepts and knowledge on different power station options for automotive applications including internal combustion engines, battery electrical vehicles, engine/battery hybrid vehicles, and fuel cell powered vehicles.

P: Graduate Standing
Typically offered in Spring only

MAE 511 Advanced Dynamics with Applications to Aerospace Systems (3 credit hours)
Basic topics in advanced dynamics and with applications to aerospace systems. Rotating coordinate systems, Euler angles, three-dimensional kinematics and kinetics, angular momentum methods and an introduction to analytical mechanics. Examples are concentrated in the area of aerospace vehicles, but the methods learned will be applicable to land-based vehicles and any engineering system undergoing rigid body rotation, e.g. wind turbines, biomechanical systems, machine tools, robotic systems, etc.

Prerequisite: (MAE 208 or PY 205) and MA 242 and (MA 301 or MA 341)
Typically offered in Fall and Summer

MAE 513 Principles of Structural Vibration (3 credit hours)
Principles of structural vibration beginning from single and multi-degree of freedom systems and extending to distributed systems. Forced system response, vibration of strings, bars, shafts and beams and an introduction to approximate methods.

Prerequisite: MAE 315
Typically offered in Fall only

MAE 515 Advanced Automotive Vehicle Dynamics (3 credit hours)
This course covers advanced materials related to mathematical models and designs in automotive vehicles as multiple degrees of freedom systems for dynamic behaviors in acceleration, braking, rollover, aerodynamics, suspections, tire, and drive train.

Prerequisite: MAE 208 or MAE 315 or MAE 472 or equivalent; or consent of the instructor
Typically offered in Spring only

MAE 517 Advanced Precision Manufacturing for Products, Systems and Processes (3 credit hours)
This is a graduate level course designed for graduate students and undergraduate seniors. This course examines precision issues for products, manufacturing machines, processes, and instruments. Modern manufacturing technologies are distinct in their multifarious nature in product sizes, materials, energy forms, theories, and information types; however, the key to their success relies on the management of precision. This course discusses issues critical to both existing precision manufacturing and future sub-micron/nano technology. Important topics include fundamental mechanical accuracies; manufacturing systems and processes; geometric dimensioning and tolerancing; process planning, tolerance charts, and statistical process control; principles of accuracy, repeatability, and resolution; error assessment and calibration; error budget; reversal principles; joint design and stiffness consideration; precision sensing and control; precision laser material processing.

Prerequisite: MAE 496 or MAE 415 or equivalent or instructor permission
Typically offered in Fall only

MAE 518 Acoustic Radiation I (3 credit hours)
Introduction to principles of acoustic radiation from vibrating bodies and their related fields. The radiation of simple sources, propagation of sound waves in confined spaces and transmission through different media.

Prerequisite: MA 301 and MAE 308 or MAE 356
Typically offered in Fall and Spring

MAE 520/MAE 420 Dynamic Analysis of Human Movement (3 credit hours)
Topics in movement biomechanics and computational analyses of movement, including muscle physiology and mechanics, advanced muscle modeling, neural control of muscle and motor control theories, and dynamic simulation and optimization. Discussion of fundamental research underpinnings and clinical and sports applications.

P: MAE208 or equivalent
Typically offered in Spring only

MAE 521 Linear Control and Design For Mimo Systems (3 credit hours)
Linear Multivariable control and design for multibody engineering systems (robotics) and aircraft controls and navigation. Emphasis on multi-input and multi-output (MIMO) system analysis and design using frequency-based approach. Controllability andobservability, transmission zeroes and pole-zero cancellation, eigenstructures, singular value decomposition in frequency domain, stability and performance robustness of MIMO systems.

Prerequisite: MAE 435, MA 341

MAE 522 Non Linear System Analysis and Control (3 credit hours)
Nonlinear system analysis, Lyapunov stability theory, absolute stability, feedback linearization, sliding mode control, backstepping control technique, as well as various advanced nonlinear control methods.

Prerequisite: MAE 521 or equivalent

MAE 525 Advanced Flight Vehicle Stability and Control (3 credit hours)
Preliminary analysis and design of flight control systems to include autopilots and stability augmentation systems. Study of effects of inertial cross-coupling and nonrigid bodies on vehicle dynamics.

Prerequisite: MAE 457
Typically offered in Fall only

MAE 526/MAE 426 Fundamentals of Product Design (3 credit hours)
Many think of design as more of an art than a science. However, the growing body of research in the engineering design community teaches us ways to navigate the design of consumer products using interdisciplinary design tools and rational decision making. This course introduces students to scientific design techniques that are more effective than "ad hoc" tactics. By exploring how engineering principles integrate with "real world" design challenges, students will learn to solve product design problems that encompass heterogeneous markets, multiple disciplines, and large-scale complex systems.

Prerequisite: MA 241
Typically offered in Spring and Summer

MAE 528 Experimental Flight Testing (3 credit hours)
Application of engineering methods to experimental flight testing of fixed-wing aircraft for determination of performance and handling qualities of air vehicles. Risk minimization techniques are included in the formulation of a flight test plan. Collected flight test data is corrected for standard day and analyzed.

Prerequisite: Graduate standing, Aerospace Engineering Majors, MAE 525
Typically offered in Spring only

MAE 531 Engineering Design Optimization (3 credit hours)
Nonlinear optimization techniques with applications in various aspects of engineering design. Terminology, problem formulation, single and multiple design variables, constraints, classical and heuristic approaches, single and multiobjective problems, response surface modeling, and tradeoffs in complex engineering systems. Numerical optimization algorithms and implementation of these optimization techniques. Graduate standing in engineering recommended.

Prerequisite: Graduate standing in Engineering is recommended.
Typically offered in Fall only

MAE 532 Smart Structures and Micro-Transducers (3 credit hours)
This course is designed for graduate students who wish to learn fundamentals and applications of smart structures and micro transducers. The course focuses on materials, structures, design, fabrication, and characterization of micro transducers. It also covers the recent progress in applications of micro transducers in aerospace, biomedical, civil, electrical and mechanical engineering.

Prerequisite: MAE 314, MAE 315, or equivalent.
Typically offered in Fall only

MAE 533 Finite Element Analysis I (3 credit hours)
Fundamental concepts of the finite element method for linear stress and deformation analysis of mechanical components. Development of truss, beam, frame, plane stress, plane strain, axisymmetric and solid elements. Isoparametric formulations. Introduction to structural dynamics. Practical modeling techniques and use of general-purpose codes for solving practical stress analysis problems.

Prerequisite: MAE 316 or MAE 472
Typically offered in Fall only

MAE 534 Mechatronics Design (3 credit hours)
Principles of Mechatronics Design, review of logic gates, microprocessor architecture, sensors and actuators, A/D and D/A conversion techniques, real-time multi-tasking programming concepts, direct digital control implementation. "Hands-on" experience through several laboratory assignments and final team project.

Prerequisite: Structured Programming Experience, Senior/Graduate Standing in WPS/MAE.
Typically offered in Fall and Spring

MAE 535/ECE 535 Design of Electromechanical Systems (3 credit hours)
A practical introduction to electromechanical systems with emphasis on modeling, analysis, design, and control techniques. Provides theory and practical tools for the design of electric machines (standard motors, linear actuators, magnetic bearings, etc). Involves some self-directed laboratory work and culuminates in an industrial design project. Topics include Maxwell's equations, electromechanical energy conversion, finite element analysis, design and control techniques.

Prerequisite: MA 341
Typically offered in Spring and Summer

MAE 536 Micro/Nano Electromechanical Systems (3 credit hours)
Fundamentals and applications of micro/nano sensors and actuators. Emphasis upon MEMS/NEMS design, microfabrication techniques, and case studies of MEMS devices. Nanomaterials and NEMS devices also covered. Students have opportunity to learn commercial software packages on design and simulation of MEMS and hear from experts from leading MEMS companies through guest lectures. Previous knowledge of MEMS and nanotechnology is not required. The course is restricted to advanced undergrads and graduate students in engineering, materials science, physics and biomedical fields.

Typically offered in Fall only

MAE 537 Mechanics Of Composite Structures (3 credit hours)
Manufacturing techniques with emphasis on selection of those producing most favorable end result. Classical plate theory, materials properties and failure theories. Micromechanics, repair, plate solutions and elasticity solutions covered as requiredto meet special interests of students.

Prerequisite: MAE 316 or MAE 472
Typically offered in Spring only

MAE 538 Smart Structures and Materials (3 credit hours)
An application-oriented introduction to smart structures and materials with examples from mechanical, aerospace and biomedical engineering. Experimentally observed phenomena, micromechanisms, and models for material behavior. Team work developing simulation tools for typical applications. Validating results experimentally using PC-based data acquisition systems.

Prerequisite: MAE 415 or MAE 472
Typically offered in Spring only

MAE 539/MSE 539 Advanced Materials (3 credit hours)
Introduces production/structure/property/function relation and application of a number of materials mainly for biomedical, mechanical and aerospace applications. Topics include ultra light materials (production, processing and applications of cellular solids), biomaterials (classes and application of materials in medicine and dentistry), composites (classes and application), refractory materials and coatings for high temperature applications, thin film shape memory alloys for micro-electro mechanical systems (MEMS).

Prerequisite: MSE 201 and MAE 314
Typically offered in Fall only

MAE 540 Advanced Air Conditioning Design (3 credit hours)
Psychrometric process representations. Heating and cooling coil design. Heat pump design. Air washer design. Direct contact heat and mass transfer systems. Ventilation requirements, air dilution calculations. Cooling load calculations; CLTD, CLF andtransfer functions methods. Room air distribution.

Prerequisite: MAE 403, 404
Typically offered in Spring only

MAE 541 Advanced Solid Mechanics I (3 credit hours)
Development of principles of advanced strength of materials and elasticity theory leading to solution of practical engineering problems concerned with stress and deformation analysis. Tensor analysis, coordinate transformations, alternative measures of strain, elastic constitutive equations, stress measures, formulation and solution of two and three dimensional elasticity problems. Examples include advanced beam theory for shear deformation and large deformation, contact mechanics, stress concentration, pressure vessels and compound cylinders, thermal stress analysis, and stresses in layered microelectronic devices.

Prerequisite: MAE 316
Typically offered in Fall only

MAE 543 Fracture Mechanics (3 credit hours)
Concept of elastic stress intensity factor, Griffith energy balance, determination of the elastic field at a sharp crack tip via eigenfunction expansion methods, J integrals analysis, experimental determination of fracture toughness, fatigue crack growth, elastic-plastic crack tip fields. Emphasis on modern numerical methods for determination of stress intensity factors, critical crack sizes and fatigue crack propagation rate predictions.

Prerequisite: MAE 316
Typically offered in Spring and Summer

MAE 544 Real Time Robotics (3 credit hours)
Real-time programming for servo control using an embedded controller. Software and hardware interfacing for control of a D.C. servo device. Introduction of multi-tasking to establish concurrent control of several processes, transforming servo loop into a process executing concurrently on single board computer. Provision for hands-on development systems and software emulators.

Prerequisite: Pascal, C, FORTRAN or Assembly language experience

MAE 545 Metrology For Precision Manufacturing (3 credit hours)
Foundations of dimensional metrology and error analysis as applied to accuracy and repeatability in machine design. Plane, length, angle, and roundness metrology. Design of precision systems, Abbe' principle, error analysis, measurement, and compensation. Precision instruments and operating principles. Hands-on experience with measurement instruments and techniques.

Prerequisite: Senior standing in MAE or BS in other curriculum
Typically offered in Spring only

MAE 546 Photonic Sensor Applications in Structure (3 credit hours)
Use of optical fiber and other photonic device based sensors to measure strain, temperature and other measurands in aerospace, mechanical, civil and biomedical applications. An introduction to optical waveguide analysis will be provided at the beginning of the course.

Prerequisite: MAE 371 or MAE 316
Typically offered in Fall only

MAE 550 Foundations Of Fluid Dynamics (3 credit hours)
Review of basic thermodynamics pertinent to gas dynamics. Detailed development of general equations governing fluid motion in both differential and integral forms. Simplification of the equations to those for specialized flow regimes. Similarity parameters. Applications to simple problems in various flow regimes.

Prerequisite: MAE 201 or MAE 252 or MAE 308
Typically offered in Fall and Summer

MAE 551 Airfoil Theory (3 credit hours)
Development of fundamental aerodynamic theory. Emphasis upon mathematical analysis and derivation of equations of motion, airfoil theory and comparison with experimental results. Introduction to super sonic flow theory.

Prerequisite: MAE 252

MAE 552 Introduction to Experimental Fluid Dynamics and Measurement Systems (3 credit hours)
This course educates graduate students in the design of experiments and basis for model testing and scaling laws; uncertainty and error analysis in selecting measurement systems for experiments; qualitative and quantitative technologies for obtaining measurements; analysis, post-processing and visualization techniques of data.

Prerequisite: MAE 308 and MAE 451 or equivalent
Typically offered in Spring only

MAE 553 Compressible Fluid Flow (3 credit hours)
Equations of motion in supersonic flow; unsteady wave motion, velocity potential equation; linearized flow; conical flow. Slender body theory. Methods of characteristics. Shockwave/ boundary layer interactions.

Prerequisite: MAE 351 or MAE 550
Typically offered in Spring only

MAE 554 Hypersonic Aerodynamics (3 credit hours)
Fundamentals of inviscid and viscous hypersonic flowfields. Classical and modern techniques for calculating shock wave shapes, expansions, surface pressures, heat transfer and skin friction. Applications to high speed aircraft, rockets and spacecraft.

Prerequisite: MAE 553

MAE 555 Applications of Acoustic and Elastic Wave Propagation (3 credit hours)
This course covers the principles for acoustic and elastic propagation in fluids and solids. Diffraction theory is developed for finite sources. The notions of wavepacket, dispersion and waveguiding are reviewed. The fundamentals of the theory of elasticity and elastic propagation in solids are introduced, based on tensor analysis. Time reversal of acoustic waves is presented, as well as applications to underwater acoustics, medical imaging and therapy, nondestructive testing, elasticity imaging.

Typically offered in Spring only

MAE 558 Microfluidics and Nanofluidics (3 credit hours)
Macroscale fluid mechanics, heat and mass transfer. Theories of microfluidics and nanofluidics. Applications in mechanical, biomedical, and chemical engineering. Discussions of journal articles and modern fluid dynamics projects. Expert guest lectures on advanced micro/nanotechnology topics.

Prerequisite: MAE 310 and MA 427
Typically offered in Spring only

MAE 560 Computational Fluid Mechanics and Heat Transfer (3 credit hours)
Introduction to integration of the governing partial differential equations of fluid flow and heat transfer by numerical finite difference and finite volume means. Methods for parabolic, hyper-bolic and elliptical equations and application to model equations. Error analysis and physical considerations.

Prerequisite: MA 501 or MA 512, MAE 550 or MAE 557, proficiency in the FORTRAN programming language is required
Typically offered in Fall only

MAE 561 Wing Theory (3 credit hours)
Discussion of inviscid flow fields over wings in subsonic flow. Vortex lattice methods, lifting surface theories and panel methods developed for wings with attached flow and leading-edge separation. Calculation of aerodynamic characteristics and determination of effects of planform and airfoil shapes.

Prerequisite: MAE 551
Typically offered in Spring only

MAE 562 Physical Gas Dynamics (3 credit hours)
Introduction to kinetic theory, statistical mechanics and chemical thermodynamics. Law of Action. Vibrational and chemical rate processes. Application to equilibrium and nonequilibrium flows.

Prerequisite: MAE 550
Typically offered in Fall only

MAE 570/MAE 470 Space Exploration Systems (3 credit hours)
This course will cover topics related to space exploration systems. In particular, the basic concepts of orbital mechanics needed for space mission planning will be covered, along with the essential subsystems found on a typical spacecraft.

Prerequisite: MAE 467 Introduction to Space Flight or Graduate Standing and Consent of Instructor
Typically offered in Fall only

MAE 573 Hydrodynamic Stability and Transition (3 credit hours)
Conceptual framework and development of hydrodynamic stability theory. Application of the theory to two-dimensional incompressible and compressible subsonic, transonic, supersonic and hypersonic flows. Results for three-dimensional flows. Introduction of mechanisms of transition and discussion of transition models in numerical methods.

Prerequisite: MAE 550
Typically offered in Spring only

MAE 575 Advanced Propulsion Systems (3 credit hours)
The course will focus on non-turbomachinery, air-breathing hypersonic aeropropulsion applications. Specific propulsion systems to be covered include ramjets and scramjets, pulsed detonation engines, and combined cycle engines, with historical perspective.

Prerequisite: Both MAE 458 and MAE 459 or both MAE 302 and MAE 308

MAE 577/NE 577 Multiscale Two-phase Flow Simulations (3 credit hours)
Modeling and simulation of two-phase flows using interface tracking approach and ensemble averaging approaches. Model validation and verification based on interface-tracking data, boiling models. Nuclear reactor applications. The course focuses on interface tracking methods understanding as applied to bubbly flow simulations. Students will develop a simplified solver to track 2D bubbles/droplets throughout the course homework assignments and will learn how to apply this approach for better understanding of multi-phase flow as part of the course project.

Typically offered in Spring only

MAE 586 Project Work In Mechanical Engineering (1-6 credit hours)
Individual or small group investigation of a problem stemming from a mutual student-faculty interest. Emphasis on providing a situation for exploiting student curiosity.

Typically offered in Fall, Spring, and Summer

MAE 589 Special Topics In Mechanical Engineering (1-6 credit hours)
Faculty and student discussions of special topics in mechanical engineering.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall and Spring

MAE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MAE 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MAE 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MAE 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

MAE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

MAE 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MAE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MAE 699 Master's Thesis Preparation (1-9 credit hours)
Individual research in the field of mechanical engineering.

Prerequisite: Graduate standing in Mechanical Engineering, Consent of Adviser
Typically offered in Fall, Spring, and Summer

MAE 702 Statistical Thermodynamics (3 credit hours)
Analysis and establishment of conclusions of classical thermodynamics from the microscopic viewpoint. Topics include: ensemble methods, partition functions, translational, rotational and vibrational energy modes of an ideal gas, chemical equilibrium, imperfect gases, dense fluids, critical-point theories, mean free path concepts, Boltzmann equation, hydrodynamic equations from kinetic theory and properties of disordered composite media.

Prerequisite: MAE 501
Typically offered in Spring only

MAE 703 Direct Energy Conversion (3 credit hours)
The course is intended to be an introduction to fundamentals of energy transport and energy conversion concepts from nano to macro scales. The course will cover the state of energy carriers (photons, electrons, and phonons) and their transport characteristics. A focus will be on material properties that dictate energy related processes. The foundational concepts will then be applied to direct energy conversion devices including thermoelectrics and photovoltaics. Finally, the course will cover system analysis of solid-state energy conversion applications.

Typically offered in Spring only

MAE 704 Fluid Dynamics of Combustion II (3 credit hours)
Advanced theory of detonation and deflagration. Ignition criteria. Direct initiation of detonation including blast-wave theory. Transition from deflagration to detonation. Combustion wave structure and stability. Liquid droplet and solid particle combustion.

Prerequisite: MAE 504
Typically offered in Spring only

MAE 707 Advanced Conductive Heat Transfer (3 credit hours)
Comprehensive, unified treatment of methodologies for solving multidimensional transient and steady heat conduction. Approximate and exact methods of solving nonlinear problems, including phase and temperature-dependent thermal properties, nonlinearboundary conditions. Heat conduction in composite media and anisotropic solids. Use of finite integral transform and Green's function techniques.

Prerequisite: MAE 505 or MA 501
Typically offered in Spring only

MAE 708 Advanced Convective Heat Transfer (3 credit hours)
Advanced topics in steady and transient, natural and forced convective heat transfer for laminar and turbulent flow through conduits and over surfaces. Mass transfer in laminar and turbulent flow. Inclusion of topics on compressible flow with heat and mass transfer.

Prerequisite: MAE 550
Typically offered in Spring only

MAE 709 Advanced Radiative Heat Transfer (3 credit hours)
Comprehensive and unified treatment of basic theories; exact and approximate methods of solution of radiative heat transfer and the interaction of radiation with conductive and convective modes of heat transfer in participating and non-participatingmedia.

Prerequisite: MAE 505
Typically offered in Fall only

MAE 718 Acoustic Radiation II (3 credit hours)
Advanced treatment of the theory of sound generation and transmission. Topics include: techniques for solution of the wave equation, radiation from spheres, cylinders and plates, sound propagation in ducts, scattering.

Prerequisite: MAE 518
Typically offered in Spring only

MAE 721 Robust Control with Convex Methods (3 credit hours)
This course emphasizes on control design techniques which result in closed-loop systems that are insensitive to modeling errors and which achieve a prespecified level of performance. Robustness margins against model uncertainty. Robust control design techniques based on linear matrix inequalities. Topics include uncertainty modeling, robust stability and performance, H_inf control, convex optimization technique (LMI), mu-analysis and synthesis, computer-aided analysis and control design.

Prerequisite: Graduate standing in Engineering and Applied Mathematics, MAE 521 or ECE 716
Typically offered in Spring only

MAE 725 Geophysical Fluid Mechanics (3 credit hours)
The principles of fluid mechanics applied to geophysical systems. Special emphasis placed on those features of these systems, such as almost rigid rotation and stable stratification, which produce unique and important effects. The effects of almost rigid rotations on homogeneous and stratified flows examined in detail.

Prerequisite: MAE 501
Typically offered in Fall only

MAE 726 Advanced Geophysical Fluid Mechanics (3 credit hours)
Principles of fluid mechanics applied to geophysical systems. Special emphasis on role of stable stratification on the flows in these systems. Detailed study of generation, interaction, propagation and dissipation of internal gravity waves. Studyof other geophysically important flows.

Prerequisite: MAE 725 or equivalent
Typically offered in Spring only

MAE 730 Modem Plasticity (3 credit hours)
Classical theories of plasticity and solutions pertaining to rate-independent and -dependent deformations modes in metals, geomaterials and concrete. Ductile failure modes, i.e., shear-strain localization and other failure modes associated with large deformation modes. Inelastic wave propagation, crystalline constitutive formulations and computational aspects of quasi-static and dynamic plasticity.

Prerequisite: Grad. course in elasticity or strength of materials
Typically offered in Fall only

MAE 731/MSE 731 Materials Processing by Deformation (3 credit hours)
Presentation of mechanical and metallurgical fundamentals of materials processing by deformation. Principles of metal working, friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

Prerequisite: Six hrs. of solid mechanics and/or materials
Typically offered in Fall only

MAE 734 Finite Element Analysis II (3 credit hours)
Advanced treatment of finite element analysis for non-linear mechanics problems, including most recent developments in efficient solution procedures. Plate bending and shell elements, computational plasticity and viscoplastic materials, large deformation formulations, initial stability and buckling, structural vibrations, incompressible elasticity, contact problems, flow in incompressible media, weighted residuals and field problems. Development of efficient algorithms for practical application.

Prerequisite: MAE 533
Typically offered in Spring only

MAE 742 Mechanical Design for Automated Assembly (3 credit hours)
Mechanical design principles important in high volume production using modern automated assembly technology. Production and component design for ease of assembly as dictated by part handling, feeding, orientation, insertion and fastening requirements. Existing product evaluation and redesign for improved assemblage.

Prerequisite: Graduate standing or PBS status in Engineering
Typically offered in Fall only

MAE 766 Computational Fluid Dynamics (3 credit hours)
Advanced computational methods for integrating, by use of finite differences, and finite volume discretizations, non-linear governing equations of fluid flow; the Euler equations and the Navier-Stokes equations. Topics from current literature.

Prerequisite: MAE 560; proficiency in the FORTRAN programming language is required
Typically offered in Spring only

MAE 770 Computation of Reacting Flows (3 credit hours)
Development of governing equations for chemically and thermally nonequilibrium flows. Numerical formulation with application to planetary entry flows and supersonic combustion. Numerical examples. Computational problems.

Prerequisite: MAE 560, MAE 766
Typically offered in Spring only

MAE 776 Turbulence (3 credit hours)
Development of basic concepts and governing equations for turbulence and turbulent field motion. Formulations of various correlation tensors and energy spectra for isotropic and nonisotropic turbulence. Introduction to turbulent transport processes,free turbulence, and wall turbulence.

Prerequisite: MAE 550
Typically offered in Spring only

MAE 787 Structural Health Monitoring (3 credit hours)
The course will provide the students with in-depth knowledge of technologies in structural health monitoring using smart materials as sensing and actuating elements to interrogate the structures. Damage detection techniques such as wave, impedance, and vibration-based damage detection techniques will be discussed and applied to different types of structures. Advanced signal processing techniques such as wavelet, neural network, principal component analysis will be used to make the damage more quantifiable.

Prerequisite: MAE 541 or MAE 513 or equivalent
Typically offered in Spring only

MAE 789 Advanced Topics In Mechanical Engineering (1-3 credit hours)
Faculty and graduate student discussions of advanced topics in contemporary mechanical engineering.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

MAE 801 Mechanical Engineering Seminar (1 credit hours)
Faculty and graduate student discussions centered around current research problems and advanced engineering theories.

Typically offered in Fall and Spring

MAE 830 Doctoral Independent Study (1-3 credit hours)
Individual investigation of advanced topics under the direction of member(s) of the graduate faculty.

Typically offered in Spring only

MAE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

MAE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MAE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MAE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Typically offered in Fall, Spring, and Summer

Mechanical Engineering Systems (MES)

MES 200 Introduction to Mechanical Engineering Systems (2 credit hours)
This course introduces students to mechanical engineering systems and its application in real-world problem solving. Using Excel and MATLAB, students will structure and solve problems. Through hands-on activities, students will become familiar with basic mechanical components, tools and machines. Students will be introduced to professionalism in engineering and develop a personal professional development plan. This course requires a field trip to a local business and students will be required to provide or arrange for their own transportation. Course contains a required laboratory component.

Corequisite: MAE 206
Typically offered in Fall only

MES 201 Mechanical Engineering Systems Lab I (2 credit hours)
Course provides an introduction to the theory and practice of manual and computer assisted laboratory measurement techniques, data analysis, design of experiments and technical report writing. Students learn to successfully conduct and document an engineering experiment. This course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.

Prerequisite: MAE 206
Typically offered in Spring only

MES 300 Systems Engineering (3 credit hours)
This course introduces the theory and practice of formal systems engineering. Students are exposed to systems thinking, systems modeling and performing engineering design within a formal systems engineering framework. They will perform requirements definition and analysis, system architecting, test and integration plan development, and formal technical reviews.

Prerequisite: MES 200 and C or better in MAE 206
Typically offered in Spring only

MES 301 Mechanical Engineering Systems Lab II (2 credit hours)
This is the first course in a series of three upper level laboratory courses MES 301, 302, and 400. In each course, students apply the measurement and experimental techniques learned in MES 201 to explore, experience and verify key theoretical mechanical engineering concepts. MES 301 focuses on the fields of fluid mechanics, dynamics of machines, digital design, and electrical engineering. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.

Prerequisite: MES 201; Corequisite: MAE 308 and MAE 315
Typically offered in Fall only

MES 302 Mechanical Engineering Systems Lab III (2 credit hours)
This is the second course in a series of three upper level laboratory courses. MES 302 focuses on the fields of fluid mechanics, dynamic systems controls, and instrumentation. Students also experience engineering design by designing, building and testing an instrumentation device for engineering measurements. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.

Prerequisite: MES 301; Corequisite: MAE 435
Typically offered in Spring only

MES 305 Mechanical Engineering Systems Lab I (1 credit hours)
Course provides an introduction to the theory and practice of manual and computer assisted laboratory measurement techniques, data analysis, design of experiments and technical report writing. Students learn to successfully conduct and document an engineering experiment. For MES Majors only.

Prerequisite: MSE 201 and MAE 206
Typically offered in Spring only

MES 400 Mechanical Engineering Systems Lab IV (2 credit hours)
This is the final course in a series of three upper level laboratory courses. MES 400 focuses on the fields of fluid mechanics, heat transfer, digital design, and solid mechanics. Students also finish the design experience started in MES 302. Course requires a field trip to a local business and students will be required to provide or arrange for their own transportation.

Prerequisite: MES 302; Corequisite: MAE 310
Typically offered in Fall only

MES 401 MES Capstone Design I (3 credit hours)
This course is first of a two-semester engineering design and manufacturing experience which is the culmination of the MES student's undergraduate education experience. In teams, students design, cost, and build a working prototype to solve a real-world engineering problem supplied by an industry partner. Students follow a systems engineering approach to manage their project through a requirements definition review, a preliminary design review, and the completion of detailed design. Students develop communication skills through reports and presentations and gain insight into engineering design through guest lectures. Students must provide any transportation needed for this class. MES students only.

Prerequisite: MES 300 and MAE 316; Corequisite: MAE 310 and MAE 415
Typically offered in Fall only

MES 402 MES Capstone Design II (4 credit hours)
This course is second in a two semester engineering design and manufacturing experience which is the culmination of the MES student's undergraduate education experience. In teams, students solve a real-world engineering problem supplied by an industry partner. In the two courses, students follow a formal systems engineering approach to manage their project through the following reviews: System Requirements, Conceptual Design, Preliminary Design, and Critical Design. Students develop written and verbal communication skills and gain insight into engineering design practices through guest lectures from local engineers. Students must provide any transportation needed for this class. MES students only.

Prerequisite: MES 401
Typically offered in Spring only

MES 403 MES Capstone Design II (3 credit hours)
This course sequence is the second in the senior capstone engineering design experience. This capstone experience is the culmination of the MES student's undergraduate education experience. Working in teams, students perform engineering design to solve a real-world engineering problem supplied by an industry partner. In MES 401 & MES 403, students follow a formal systems engineering approach to manage their design project through the completion of a System Requirements Review, a Conceptual Design Review, a Preliminary Design Review, a Detailed Design Review, and a Critical Design Review. Students develop written and verbal communication skills through reports and presentations. Students also gain insight into engineering design practices through guest lectures from local engineers. Course requires travel to sponsor and students are required to provide or arrange for their own transportation.

Prerequisite: MES 401
Typically offered in Spring only

MES 405 Mechanical Engineering Systems Lab II (2 credit hours)
In this course, students apply the measurement and experimental techniques learned in MES 305 to explore, experience and verify key theoretical concepts from the fields of thermal science, fluid mechanics, solid mechanics, and dynamics and controls. Students learn to successfully design, conduct, analyze, document and present a statistically sound engineering experiment. For MES students only.

Prerequisite: MES 305 and MAE 314 and MAE 308; Corequisite: MAE 435 and MAE 310
Typically offered in Fall only

Medical Textiles (MT)

MT 105 Introduction to Medical Textiles (3 credit hours)
Introduction to the structures and methods of production of polymers, fibers, yarns and fabrics used in medical applications. Survey of the performance requirements of current medical textiles and healthcare products used in health centers, as surgical implants and as consumer products. Overview of the structure, organization and integration of the medical textile, medical device and pharmaceutical industries within the healthcare sector. Credit not allowed if previous credit for TT 105

Typically offered in Fall and Spring

MT 323 Introduction to Theory and Practice of Medical Fiber and Yarn Formation (3 credit hours)
Introduction to the manufacture of fibers and filament yarns used in medical textiles. It includes the flow behavior of polymeric materials as it relates to fiber formation. It also includes the application of fiber forming theories to synthetic and biopolymeric fibers used in medical textiles. The common methods of yarn manufacture are introduced.

Prerequisite: (PY 211 or (PY 205 and PY 206)) and (PCC 203 or CH 221 or CH 225 or TE 200)
Typically offered in Fall and Spring

MT 366 Biotextile Product Development (3 credit hours)
Overview of the product development process for medical textiles and implantable biotextile devices. FDA classification system for medical and healthcare products. Review steps in identification of healthcare needs, market size and demand, product specifications and design, prototype fabrication and sterilization, in vitro testing of mechanical, chemical, surface and biological properties, in vivo animal testing, regulatory issues, consumer and clinical trials and explant analysis. Examples of medical textiles for personal hygiene, wound care, external support, orthopedic, general surgery, dental and tissue engineering applications. The student will be introduced to the process of new product development as it applies to medical textiles and biotextiles.

Prerequisite: (TT 105 or MT 105 or PCC 105), (TE 200 or CH 223 or 227), and TT 327: Co-requisite: TT 404, TT 341, and TT 351
Typically offered in Spring only

MT 381 Medical Textile and the Regulatory Environment (3 credit hours)
The course will focus on the legal and regulatory environment as it impacts the design, manufacture, marketing and distribution of medical textiles and healthcare products. Fundamentals of legal theory, contract law, intellectual property, licensing, product liability and the Food and Drug Administration will be covered, providing the student with the ability to recognize and understand the legal issues involved with the medical textile supply chain.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

MT 432 Biotextiles Evaluation (3 credit hours)
Evaluation of the performance of biotextiles and medical polymers in biological and microbiological environments, with an emphasis on in vitro and in vivo techniques for testing the biocompatibility and biostability of implantable biomedical products. Related issues will deal with quality assurance systems, inspection and sampling plans, ISO certification, good manufacturing practices, reference materials and organisms, and the use of accelerated tests and animal trials so as to meet regulatory requirements.

Prerequisite: TT 327 or MT 323 and BIO 183; Corequisite: MT 366 or TE 466
Typically offered in Fall only

MT 471/PCC 471 The Chemistry of Synthetic and Natural Bipolymers (3 credit hours)
Introduction to natural and synthetic biopolymers used for biomedical applications. Goals and challenges of biomaterials selection for biomedical engineering. Polymer concepts of polymerization and characterization. Sources/synthesis, chemical and physical properties and degradation mechanisms are described. Polymer classes include: polysaccharides, proteins, polyesters, polyurethanes, polyanhydrides and polyethers.

Prerequisite: CH 220 or 221 or 225
Typically offered in Spring only

Microbiology (MB)

MB 101/BCH 101 Introduction to Microbiology and Biochemistry Laboratory Practices (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. A "hands on" introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.

Typically offered in Summer only

MB 103 Introductory Topics in Microbiology (1 credit hours)
Introduction to scope and objectives of university education. Emphasis on microbiology. Career opportunities, computers, university resources.

Typically offered in Fall only

MB 180 Introduction to Microbial Bioprocessing (3 credit hours)
Curricular bridge between high school and college for high school and transitional students. Fundamental cell biology concepts pertaining to biomanufacturing. Students gain an understanding of the basic principles of microbiology, culture preparation, physiology, and genetics of microbial cell cultures. Team-based decisions, collaborations and consideration of multiple perspectives are emphasized. Practical experience in laboratory and culture techniques used in biomanufacturing. Transportation will be provided for field trips. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS), as well as other pre-college, transitional and early-college programs. Suitable for students with less than 30 credit hours.

Typically offered in Summer only

MB 200 The Fourth Horseman: Plagues that Changed the World (3 credit hours)
An integrated and in-depth study of select microbial pathogens and their influence on history, public health, and human affairs. Five major pathogens will be examined to identify causative agents of disease, modes of transmission, prevention, and treatment. These pathogens will be framed in the power of plagues to shape human history and their impact on public health.

GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MB 210/BIT 210 Phage Hunters (3 credit hours)
This course offers first-year students an opportunity for mentored research. Students will apply the scientific method to make novel discoveries. Students will isolate and characterize naturally-occurring bacteriophage (viruses that infect bacteria, but not humans) from the environment. They will present their data to each other, and the genome of one phage will be sequenced. Students have the option to continue in a second semester to annotate that genome, culminating in a submission to genbank and a poster presentation. Students in the course are part of the National Genome Research Initiative funded by The Howard Hughes Medical Institute. Student should have had a high school biology course before taking this course.

GEP Natural Sciences
Typically offered in Fall only

MB 211/BIT 211 Phage Genomics (2 credit hours)
This course offers first-year students an opportunity for mentored research. Student will apply the scientific method to make novel discoveries. Students will build on the work they began in BIT/MB 210; The novel phage isolated in the previous semester will undergo genome sequencing over winter break, and in this course students will learn to analyze and annotate the genome sequence. This semester will culminate in a submission to genbank and a poster presentation. Students in the course are part of the national genome research initiative funded by the Howard Hughes Medical Institute.

Prerequisite: BIT(MB) 210
GEP Natural Sciences
Typically offered in Spring only

MB 351 General Microbiology (3 credit hours)
Rigorous introduction to basic principles of microbiology for students in biological and agricultural sciences and for all students planning to take further courses in microbiology.

Prerequisite: One Biology course (BIO 181, BIO 183, ZO 150 or ZO 160) and one Organic Chemistry course (CH 221 or CH 220)
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

MB 352 General Microbiology Laboratory (1 credit hours)
Laboratory experience in general microbiology. Aseptic technique, isolation and identification of bacteria, staining and microscopy. Enumeration of bacteria and viruses. Students who have completed either MB (BEC) 320 or MB 354 may not take this course for credit.

Corequisite: MB 351
Typically offered in Fall, Spring, and Summer

MB 354 Inquiry-Guided Microbiology Lab (1 credit hours)
Inquiry-guided laboratory experience in general microbiology, for microbiology majors and honors students, and those desiring a more rigorous exposure to this topic. Aseptic technique, isolation and identification of bacteria, staining and microscopy, and Koch's postulates. Restricted to microbiology majors and honor's students. Others require departmental permission. Credit is not allowed for both MB 354 and either Mb 320 or MB 352.

Corequisite: MB 351
Typically offered in Fall and Spring

MB 360 Scientific Inquiry in Microbiology: At the Bench (3 credit hours)
Scientific questions, controls and variables, designing, preparing for and carrying out experiments, keeping a notebook, interpreting results, and presenting their findings: i.e. the pragmatic things a student must know in order to work efficiently in a research lab regardless of the discipline. Prior or current enrollment in MB 352 or MB 354 recommended.

Prerequisite:CH 101 and BIO 183 (both with a C- or better)
Typically offered in Fall only

MB 405/FS 505/MB 505/FS 405 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

MB 406/FS 506/MB 506/FS 406 Food Microbiology Lab (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

MB 411 Medical Microbiology (3 credit hours)
Comprehensive study of microbial pathogenesis and mammalian host resistance. Diagnosis, prevention, and therapy of common human diseases of microbial origin.

Prerequisite: MB 351
Typically offered in Fall and Spring

MB 412 Medical Microbiology Laboratory (1 credit hours)
Laboratory experience to complement MB 411. Techniques of detection, growth and identification of bacteria and viruses relevant in clinical microbiology laboratories. Good laboratory practices (GLP) and safety stressed.

Prerequisite: MB 352 or MB 354 and Corequisite: MB 411
Typically offered in Spring only

MB 414 Microbial Metabolic Regulation (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through an analysis of metabolic regulatory functions.

Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

MB 420/MB 520 Fundamentals of Microbial Cell Biotransformations (2 credit hours)
This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.

Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

MB 435/MB 535 Bacterial Pathogenesis (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert hos defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed. Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.

Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

MB 441 Immunology (3 credit hours)
Introduction to principles of molecular immunology. Overview of immune system development and function, and discussions of ongoing scientific research regarding immune regulation.

P: C- or better in (MB 351 or BCH 351 or BCH 451 or BIO 414 or PB 414 or BIO 421)
Typically offered in Fall and Spring

MB 451 Microbial Diversity (3 credit hours)
Molecular, biochemical, and evolutionary diversity of the microbial world, including Bacteria, Archaea, and Eukaryotes. Evolutionary perspective on microbial relationships, molecular methods of study and classical and modern biotechnological methods utilizing this genetic diversity to explore the microbial world and use the resulting insight to meet the needs of our own species.

Prerequisite: MB 411 and (GN 311 or BCH 351 or BCH 451)
Typically offered in Fall and Spring

MB 452 Microbial Diversity Lab (2 credit hours)
This lab course is project-oriented. Students perform a series of classical enrichments and isolations, starting from environmental samples collected by the students themselves. Some of these isolations serve as the starting materials for a series of modern molecular biology experiments, in which students purify DNA, amplify ribosomal DNA by PCR, and have a portion of this gene sequenced. This sequence information is the starting point for the term project, a detailed molecular phylogenetic analysis of the isolated organisms. Students will be required to provide their own transportation during non-scheduled class time for local field sample collection.

Prerequisite: MB 412; Corequisite: MB 451
Typically offered in Fall only

MB 455 Microbial Biotechnology (3 credit hours)
Introduction to industrial microbiology with focus on biotechnology including developments employing recombinant nucleic acid and monoclonal antibody techniques. Bioremediation, industrial enzymes, transgenic plants, biopesticides, medical diagnostics, recombinant vaccines production of important secondary metabolites, and other topics. Field trips to local biotechnology companies.

Prerequisite: MB 351 and GN 311
Typically offered in Spring only

MB 461 Molecular Virology (3 credit hours)
Introduction to principles of molecular virology. Overview of classification and nomenclature, virus structure, interaction of viruses with cells, organisms (immunology, pathology), and populations (epidemiology). Detailed case studies from major groups of viruses; picornaviruses, togaviruses, orthomyxoviruses, retroviruses, polyomaviruses, and herpesviruses.

Prerequisite: MB 351, MB 411
Typically offered in Spring only

MB 470 Emerging and Re-emerging Infectious Diseases (3 credit hours)
Human behavior plays a big part in the emergence and reemergence of infectious diseases. Humanity encroaches consistently into previously uninhabited parts of the planet increasing the risk of exposure to novel pathogens that have the potential to jump into the human host or livestock. In addition to exposure to new diseases the complexities of politics and global relations often create opportunities for the re-emergence of infections that were once thought to be under control. This course aims to provide students interested in the health sciences with a foundation to understand the principles governing emergence of diseases.

Prerequisite: MB 351
Typically offered in Spring only

MB 479/MB 579 Microbial Symbiosis & Microbiomes (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.

Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 480 Current Issues in Microbiology (1 credit hours)
Library research on current topics in all areas of microbiology. Presentation of research results orally and in the form of a major term paper.

Prerequisite: SMB majors or minors, Senior standing, and MB 351
Typically offered in Fall and Spring

MB 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

MB 501/PP 501/PB 501 Biology of Plant Pathogens (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.

Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

MB 505/FS 405/MB 405/FS 505 Food Microbiology (3 credit hours)
Microorganisms of importance in foods and their metabolic activities. Source of microbial contamination during food production, processing and storage. Microbial spoilage; foods as vectors of human pathogens. Physical and chemical destruction of microorganisms in foods and the kinetics involved. Conversions of raw foods by microorganisms into food products. Microbiological standards for regulatory and trade purposes. Credit will not be given for both FS/MB 405 and FS/MB 505.

Prerequisite: MB 351
Typically offered in Spring only

MB 506/FS 406/MB 406/FS 506 Food Microbiology Lab (1 credit hours)
Laboratory experience to complement FS/MB 405. Skills in detecting and quantitating microorganisms and their toxins in foods. Application of colony and direct microscopic counts, most probable numbers, enzyme immunoassays, nucleic acid probes and computer modeling are used to understand the numbers and types of microorganisms or microbial end products in foods. Laboratory safety and oral and written reports are emphasized.

Prerequisite: MB 351 and Corequisite: FS 405 or FS 505
Typically offered in Spring only

MB 520/MB 420 Fundamentals of Microbial Cell Biotransformations (2 credit hours)
This is a half-semester course. Basic microbial cell culture theory and practice: cell physiology, mass balances, and metabolic control as seen in a dynamic bioreactor process to be scalable, consistent, and robust. The lab portion of the course provides students with hands-on experience in culture techniques using bioreactors. Students who have completed MB(BEC) 520 may not take BEC (MB) 420 for credit.

Prerequisite: MB 352 OR Corequisite of BEC(MB) 320
Typically offered in Fall only

MB 532/SSC 532 Soil Microbiology (4 credit hours)
Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality.

Prerequisite: MB 351, CH 220

MB 535/MB 435 Bacterial Pathogenesis (3 credit hours)
Focuses on basic principles of bacterial pathogenesis, including mechanisms utilized by these microbes to attach/adhere, internalize or invade, and disseminate through their animal hosts. Bacterial strategies to subvert hos defenses and persist within their animal hosts defense mechanisms, and virulence gene regulation will also be discussed. Students cannot get credit for both MB 435 and MB 535. Graduate status required for MB 535.

Prerequisite: MB 411, Graduate standing
Typically offered in Spring only

MB 555 Microbial Biotechnology (3 credit hours)
Overview of industrial microbiology focusing on current biotechnology methods (bacteria, yeast, fungi) employing rDNA, optimization of heterologous gene expression, microbial metabolic pathway engineering, metabolomics, protein engineering and recombinant antibodies. Genetic and pathway engineering strategies for developing new microbes to screen for new therapeutic compounds or overproduce: primary metabolites, antibiotics, biotherapeutic proteins, industrially useful enzymes, medical diagnostics, recombinant vaccines, biopolymers. Utilization of biofilms, methods to immobilize biocatalysts, and microbial kinetics are also covered. Field trip to local biotechnology company. Students cannot receive credit for both 455 and 555.

Prerequisite: Undergraduate microbiology, genetics, and biochemistry course: MB351, BCH 351, and GN 311
Typically offered in Spring only

MB 575/PP 575/PB 575 Introduction to Mycology (4 credit hours)
A survey of the fungal kingdom in context of phyla and classes. Systematics, ecology, biology and utilization. Illustrative material, cultural techniques in laboratories. Collection and paper required.

Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

MB 579/MB 479 Microbial Symbiosis & Microbiomes (3 credit hours)
Microbial symbioses affect all life on earth. A recent surge of research has identified the critical role of microbial symbionts in maintaining host health and well-being, for example by mediating the breakdown of food for host nutrition, priming the immune system and directly fighting off pathogenic bacteria, and triggering key physiological outcomes associated with behavior and development. This course explores core topics in the study of microbial symbioses, including partner recognition and communication, adaptations to host association, the role of symbiosis in genome evolution and ecology, and the effects of microbial symbiosis on host health. Lectures and discussions will draw heavily from the primary literature in the field of microbiome/symbiosis research, focusing on the most recent discoveries, key methodological advancements, and on diverse associations ranging from marine symbioses to the human microbiome.

Prerequisite: MB 351 General Microbiology
Typically offered in Fall only

MB 585 Industry Case Studies in Microbial Biotechnology (3 credit hours)
Project-based course directly working with biotechnology and pharmaceutical companies. Students work in teams on a company-specific project. Projects range from developing business or marketing plans for new products; writing Small Business Innovation Research (SBIR) grants or white papers; creating procedures, protocols, and/or process improvements for a company-specific process; and studying intellectual property issues. Written and oral communication skills as well as teamwork, flexibility, and ambiguity management are emphasized. Restricted to MBT students.

Typically offered in Fall and Spring

MB 590 Topical Problems (1-3 credit hours)
Informal group discussion of prepared topics assigned by instructor.

Prerequisite: Graduate standing

MB 601 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

MB 610 Special Topics Microbiology (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.

Typically offered in Fall, Spring, and Summer

MB 620 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.

Typically offered in Fall, Spring, and Summer

MB 624 Topical Problems (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 670 Laboratory Research Methods (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant to each laboratory. Microbiology graduate students only.

Typically offered in Fall only

MB 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 686 Teaching Experience (1 credit hours)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.

Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring and Summer

MB 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring and Summer

MB 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

MB 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

MB 714 Microbial Metabolic Regulation (3 credit hours)
An integrative perspective on bacterial physiology and metabolism through analysis of metabolic regulatory functions.

Prerequisite: MB 351 and either BCH 351 or 451
Typically offered in Fall only

MB 715/PP 715 Applied Evolutionary Analysis of Population Genetic Data (3 credit hours)
This course will introduce nonparametric and model-based methods for making inferences on population processes (mutation, migration, drift, recombination, and selection). The goal is to provide a conceptual overview of these methods and hands-on training on how to implement and interpret the results. Sample data sets in computer laboratories will integrate summary statistic, cladistic, coalescent, and bayesian approaches to examine population processes in different pathosystems with specific emphasis on eukaryotic microbes, viruses and bacteria.

MB 718 Introductory Virology (3 credit hours)
Introduction to principles of virology including: classification and nomenclature, epidemiology, structure, genome replication, gene expression strategies and cellular infection cycle. Major groups of viruses including those with DNA genomes and positive-sense or negative-sense RNA genomes.

Prerequisite: BCH 451 or GN 411 or MB 351
Typically offered in Fall only

MB 725/FS 725 Fermentation Microbiology (3 credit hours)
Fermentation bioprocessing and characteristics, function and ecology of responsible microorganisms. Fermentative activities, growth responses and culture interactions related to metabolism, physiology and genetics of lactic acid bacteria and selected yeasts and molds. Current developments in starter culture technology and genetics; application to food and industrial fermentations.

Prerequisite: BCH 451, MB 351
Typically offered in Spring only

MB 751/IMM 751 Immunology (3 credit hours)
Introduction to mechanisms of immunity in man and animals. Emphasis on interactions between cells of the immune system in production of immune responses and the molecules in control of these interactions.

Prerequisite: BCH 451, GN 411, MB 351
Typically offered in Spring only

MB 758/GN 758 Microbial Genetics & Genomics (3 credit hours)
Structure and function in microbial genetics, with emphasis on microbial genome organization, stable maintenance and evolution. DNA mutation and repair pathways, transcriptional and translational regulation, DNA replication and recombination and characterization of recombinant DNA molecules. Applications of genetic and genomic analysis methods to microbial processes, including strain construction, genome manipulation, and enhancement of gene expression.

Prerequisite: BCH 451 or GN 311
Typically offered in Spring only

MB 774/PB 774 Phycology (3 credit hours)
Introduction to taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention to local freshwater flow and physiology of selected species in relation to algal blooms, water quality and nutrient loading in aquatic habitats.

Typically offered in Spring only

MB 783/CBS 783/IMM 783 Advanced Immunology (3 credit hours)
In depth study of the basic cellular and molecular mechanisms of immunity, including antigen processing and presentation, T cell development, initiation of the immune response, effector mechanisms, and immunological memory. The course is designed for advanced graduate students who wish to focus on the current concepts in immunology.

Prerequisite: MB (IMM) 751
Typically offered in Fall only

MB 790 Topical Problems (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

MB 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

MB 810 Special Topics Microbiology (1-6 credit hours)
The study of special problems and selected topics of current interest in microbiology and related fields.

Typically offered in Fall, Spring, and Summer

MB 820 Special Problems (1-6 credit hours)
Selection of a subject by each student on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in microbiology.

Typically offered in Spring and Summer

MB 824 Topical Problems (1-3 credit hours)
Prerequisite: Graduate standing
Typically offered in Spring only

MB 870 Doctoral Lab Rotations (1-3 credit hours)
Directed research of microbiology graduate students in departmental laboratories prior to selecting thesis research topic. Selection of a minimum of three laboratories for research experience lasting 3 to 5 weeks. Acquisition of research methods relevant to each laboratory. Microbiology graduate students only.

Typically offered in Fall only

MB 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 886 Teaching Experience (1 credit hours)
Faculty mentoring in didactic and methodological aspects of teaching, including instructional technology as well as design and grading of assessment instruments. Provision of individual performance evaluations to encourage enhancement of teaching skills. Microbiology graduate students only.

Prerequisite: Microbiology Graduate student
Typically offered in Fall, Spring, and Summer

MB 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

MB 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

MB 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Military Science (MS)

MS 101 Introduction to Leadership and Values I (1 credit hours)
This course introduces students to fundamental components of service as an officer in the United State Army. Initial lessons form building blocks of progressive lessons in values, fitness, leadership and officership. Classroom instruction includes"life skills" including physical and mental fitness, communication theory, and interpersonal relationships. Upon completion, students will be prepared to receive more complex leadership instruction.

Prerequisite: Freshman standing or Sophomore standing
Typically offered in Fall only

MS 102 Basic Military Leadership (1 credit hours)
Familiarizes students with the fundamentals of map reading, land navigation techniques, small unit tactics and leadership, personal goal setting, Army Leadership and values, ethical decision making as well as Army basics.

Typically offered in Spring only

MS 201 Intermediate Leadership Theory I (2 credit hours)
Instruction is orientated on communication and leadership theory using practical exercise to apply communications and leadership concepts. Critical "life skills" and their relevance to success in the Army are stressed. Upon completion of this course, students will understand fundamental principles of leadership, and be prepared to intensity practical application in subsequent coursework.

Typically offered in Fall only

MS 202 Intermediate Leadership Theory II (2 credit hours)
This course focuses on the purpose, roles, and obligations of commissioned officers. Coursework will include origins of Army institutional values and practical application in decision making and leadership. Upon completion of this course, studentswill possess and understanding of leadership and officership, demonstrate the ability to apply these skills, and be prepared for the Advanced Military Science Program.

Prerequisite: MS 101
Typically offered in Spring only

MS 295 Special Topics in Military Leadership (3 credit hours)
Intensive supervised study in applied military leadership and management in an organization or historically applied scenario. Departmental approval required.

Typically offered in Fall and Spring

MS 301 Military Leadership and Training Management (3 credit hours)
Organizational leadership and processes in the Army; leadership activities and key management functions. Management and conduct of group training activities.

Prerequisite: ROTC advanced course cadet
Typically offered in Fall only

MS 302 Applied Leadership in Small Unit Operations (3 credit hours)
This course covers the fundamentals of Army Leadership, Officership, Army Values and Ethics, Personal Development, and small unit tactics at the platoon level. At the conclusion of this course, students will be capable of planning, coordinating, navigating, motivating and leading a squad and platoon in the execution of a mission during a classroom PE, a Leadership Lab, or during a Field Training Exercise (FTX). Students will write peer evaluations and receive feedback on his/her abilities as a leader and how to improve those leader skills that can further develop into a successful Army Officer.

Prerequisite: ROTC Advanced Course Cadets
GEP Social Sciences
Typically offered in Spring only

MS 401 Advanced Military Science - Leadership and Systems Management (3 credit hours)
A course designed to familiarize the student with the fundamentals of staff operations and procedures, military correspondence, and the U.S. Army training management system. Also included are the Officer Personnel Management and Officer Evaluation Report systems (OPMS/OER), the Army logistics system, mobilization and deployment, and intelligence/electronic warfare.

Prerequisite: MS 301, MS 302
Typically offered in Fall only

MS 402 Advanced Military Science - Military Justice, Ethics and Professionalism (3 credit hours)
The role of military justice, the Uniform Code of Military Justice (UCMJ) and the procedures for accomplishing certain legal actions. Ethics and professionalism of the officer corps. Also included are counseling techniques and continued preparation for the transition from cadet to commissioned officer. Emphasis on student interaction and small group exercise practical application.

Prerequisite: MS 401
Typically offered in Spring only

MS 495 Special Topics in Military Science (3 credit hours)
Individualized readings/research of Company Command level issues and implementation of the Uniform Code of Military Justice, DOD Policies, and additional duties required of company grade officers. Departmental approval required-advanced course students only.

Typically offered in Fall and Spring

Multidisciplinary Studies (MDS)

MDS 595 Special Topics in Multidisciplinary Studies (1-6 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

Music (MUS)

MUS 103 Theory and Musicianship I (3 credit hours)
This is the first course in a sequence for students interested in a concentrated study of music theory and musicianship. In addition to the fundamental principles of pitch, rhythm, meter, scales, keys, intervals, triads, and seventh chords, this course integrates subjects on musical expression, timbre, texture, performance, and composition.

Co-requisite: Students must take MUS 103 either prior to or concurrently with MUS 104
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 104 Theory and Musicianship Lab I (1 credit hours)
This is the first course in a sequence that develops aural perception skills in the principles of theory and musicianship through sight-singing and rhythm reading; scale, interval, and chord identification; melodic and rhythmic error detection; and melodic, rhythmic, and harmonic dictation. This course serves as a lab for MUS 103. Students may be able to test out of MUS 104 by means of a placement test.

Corequisite: MUS 103 either together with or before MUS 104. If a student withdraws from MUS 103, they must also withdraw from MUS 104.
Typically offered in Fall and Spring

MUS 105 Introduction to Music in Western Society (3 credit hours)
Introduction to the art of music in Western society, for the general student. Focuses on the western art music tradition, including stylistic periods from medieval to post-modern. Begins with the study of basic musical elements, formal principles and compositional techniques. This course may require students to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 107 Class Piano I (1 credit hours)
Introduction to playing the piano by learning the basics of music notation, five-finger scales, and beginner's repertoire based on hand position.

Typically offered in Fall and Spring

MUS 111 University Singers (1 credit hours)
Students study, rehearse, and perform vocal music. This ensemble is dedicated to achieving musical excellence through the performance of choral works of art at the highest possible level, to the development of choral performance skills, and to the cultivation of significant aesthetic experiences through music. This course includes instruction in ensemble musicianship, rehearsal protocols, individual vocal techniques, and discussion of the historical and musical significance of assigned repertoire. There may be a charge for concert dress not to exceed $120, and students may be asked to provide individual transportation to off-campus performances. An audition is required.

Typically offered in Fall and Spring

MUS 112 Men's Choir (1 credit hours)
Rehearsal and performance of choral repertoire for men's voices. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue.

Typically offered in Fall and Spring

MUS 113 Women's Choir (1 credit hours)
Rehearsal and performance choral repertoire for women's voices. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 114 Chamber SIngers (1 credit hours)
Rehearsal and performance of choral repertoire for small vocal ensemble. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 115 State Chorale (1 credit hours)
Rehearsal and performance of advanced choral repertoire from all eras. Includes instruction in individual vocal techniques, rehearsal protocols, and discussion of historical and musical significance of repertoire. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide their own transportation to a local performance venue. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 116 African American Choral Ensemble (1 credit hours)
Students study and perform vocal music of the African diaspora, including spirituals, folk forms, traditional and contemporary gospel, and formally-composed choral works by composers of African descent. This course includes instruction in individual vocal techniques, rehearsal protocols, and discussion of the historical and musical significance of assigned repertoire. There may be a charge for concert dress not to exceed $100, and students may be asked to provide individual transportation to off-campus performances. This course may be taken for up to 10 semesters for credit. An audition is required.

Typically offered in Fall and Spring

MUS 120 Introduction to Music Theory (3 credit hours)
This course is designed for students interested in a fundamental study of the materials of music, including pitch, rhythm, meter, scales, keys, intervals, triads, and seventh chords. Intended for students with minimal or no music theory background, this course develops skills in reading, writing, and analyzing a wide variety of music.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 121 Raleigh Civic Symphony (1 credit hours)
Rehearsal and performance of significant repertoire for symphony orchestra from the 18th-21st centuries, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance.

Typically offered in Fall and Spring

MUS 122 Raleigh Civic Chamber Orchestra (1 credit hours)
Rehearsal and performance of significant repertoire for chamber orchestra from the 17th-21st centuries, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit . Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated for up to 10 semesters.

Typically offered in Fall and Spring

MUS 131 Marching Band (1 credit hours)
Rehearsal and performance of repertoire for marching band. Study of drill and instrumental techniques, memorization, and repertoire of varying styles for large ensemble. May be repeated for credit. There is a band uniform charge; transportation to performances will be provided. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall only

MUS 132 Varsity Band (1 credit hours)
Rehearsal and performance of repertoire for varsity or athletic band. Study of instrumental techniques and repertoire of varying styles for large ensemble. May be repeated for credit. There is a band uniform charge; transportation to performances will be provided. Audition required. May be repeated up to 10 semesters.

Typically offered in Spring only

MUS 133 British Brass Band (1 credit hours)
British Brass Band provides an ensemble performing experience in a wide range of musical styles in the British Brass Band musical medium. Music is selected to provide a challenging opportunity for musical growth. Students must provide their own transportation to off-campus events. There is a charge to the student to check out a department-owned instrument.

Prerequisite: Audition required
Typically offered in Spring only

MUS 134 Wind Ensemble (1 credit hours)
Rehearsal and performance of significant repertoire for wind ensemble, including individual practice techniques, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Possible charge for concert dress. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated for up to 10 semesters.

Typically offered in Fall and Spring

MUS 135 Symphonic Band (1 credit hours)
Students rehearse and publicly perform repertoire for symphonic band, which includes a study of individual practice techniques, rehearsal and performance protocols, and the historical and musical significance of the repertoire. There may be a nominal charge for concert dress and instrument rental, and students may be asked to provide individual transportation to off-campus performances. Although auditions are not required, students must have had at least one year of lessons or performance experience on their instrument. This course may be taken for up to 10 semesters for credit.

Typically offered in Fall and Spring

MUS 140 Jazz Improvisation (1 credit hours)
Study of basic and advanced techniques for jazz improvisation, including in-class performance and study of historical models. May be repeated for credit up to ten semesters. Audition required.

Typically offered in Fall only

MUS 141 Jazz Combo II (1 credit hours)
Rehearsal and performance of basic to advanced repertoire for small jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 142 Jazz Ensemble II (1 credit hours)
Rehearsal and performance of basic to advanced repertoire for jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 143 Jazz Combo I (1 credit hours)
Rehearsal and performance of advanced repertoire for small jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 144 Jazz Ensemble I (1 credit hours)
Rehearsal and performance of advanced repertoire for jazz ensemble, including individual practice techniques, improvisation, rehearsal protocols, discussion of historical and musical significance of repertoire, and public performances. May be repeated for credit. Students may be asked to provide individual transportation to an off-campus local performance. Audition required. May be repeated up to 10 semesters.

Typically offered in Fall and Spring

MUS 150 Vocal Techniques (1 credit hours)
Development and practice of vocal techniques suitable to solo and ensemble singing in a variety of musical styles, both historical and contemporary.

Typically offered in Fall and Spring

MUS 152 Beginning Bagpiping (1 credit hours)
Instruction in bagpiping, including individual practice techniques and traditional performance practices. Prepares students for advancement into the NC State Pipes and Drums Band. Students will be required to purchase a bagpipe chanter and to provide individual transportation to off-campus performances. The ability to read music is not required upon entry. This course may be taken up to 6 semesters for credit.

Typically offered in Fall and Spring

MUS 153 Theory and Musicianship II (3 credit hours)
This is the second course in a sequence for students interested in a concentrated study of music theory and musicianship. Topics include harmonic analysis, part-writing, seventh chords, nonharmonic tones, melodic organization, harmonic progression and expansion, harmonic rhythm, and tonicization.

Prerequisites: Placement Tests or C- or better in MUS 103 and MUS 104; Corequisites: MUS 154 either together with or after MUS 153.
Typically offered in Spring only

MUS 154 Theory and Musicianship Lab II (1 credit hours)
This is the second course in a sequence that develops aural perception skills in the principles of theory and musicianship through sight-singing and rhythm reading; interval and chord identification; melodic, rhythmic, and harmonic error detection; and melodic, rhythmic, and harmonic dictation. This course serves as a lab for MUS 153.

Prerequisite: MUS 103 and 104, or placement tests; Corequisites: MUS 153. Students must take MUS 153 either together with or before MUS 154. If a student withdraws from MUS 153, they must also withdraw from MUS 154.
Typically offered in Spring only

MUS 180 Introduction to Musical Experiences (3 credit hours)
Examination of western musical materials, forms, styles and history through the primary musical experiences of composing, performing, and listening. Course designed for students with no formal musical training.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 181 Exploring Music Theory (3 credit hours)
Exploring music theory provides the student insight into Basic theoretical elements of music from Western civilization, which are fundamental to analysis and creation of musical compositions. The course will cover tonality, rhythm, intervals, triads, composition of melodies, harmonic progressions, and lead sheets. This course will enrich the student who performs, sings, composes, and enjoys listening to music.

Prerequisite: Ability to read music
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 190 Preparatory Applied Music Lessons (1 credit hours)
This course offers individual instruction in voice or instrumental performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester evaluation serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. This course may be taken for up to 2 semesters for credit.
Prerequisite: Department Approval

Typically offered in Fall and Spring

MUS 193 Applied Music Lessons I (1 credit hours)
Designed for the first two semesters of a four-semester program of study, this course offers individual instruction in voice or instrumental performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event.

Requisite: Music Minors Only
Typically offered in Fall and Spring

MUS 200 Understanding Music: Global Perspectives (3 credit hours)
Understanding Music is a semester-long exploration of music's materials, contexts, and purposes. We will consider music as a global phenomenon and commonality of human social experience. Through videos, readings and listening to both recorded and live music from diverse world regions, we will examine the occasions and purposes of music making and listening. We will explore the ways in which traditions, values, belief systems, and patterns of social change are encoded and made manifest in musical practices. The ability to read music is not expected. This course can fulfill either the Interdisciplinary Perspectives (IP) or Visual & Performing Arts (VPA) GEP requirements, and the Global Knowledge (GK) co-requisite requirement.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

MUS 201 Introduction to Music Literature I (3 credit hours)
Survey of Western art music from antiquity to the mid-18th century, with an emphasis on the characteristic forms and styles of he Medieval, Renaissance, and Baroque eras. This course examines the major composers and representative works in light of social, political, and cultural influences. The ability to read music is required.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 202 Introduction to Music Literature II (3 credit hours)
Survey of Western art music from the mid-18th century to the present, with an emphasis on the characteristic forms and styles of the late Baroque, Classical, Romantic, and Contemporary eras. This course examines the major composers and representative works in light of social, political, and cultural influences. The ability to read music is required. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 203A Theory and Musicianship III (3 credit hours)
As a continuation of MUS 153 (Theory and Musicianship II), this course examines compositional processes in chromatic harmony and musical form. Students acquire fluency in the written comprehension of these processes through analysis, problem solving, and notation. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 153 (Theory and Musicianship II); Corequisite: MUS 204 either after or simultaneously with MUS 203
Typically offered in Fall only

MUS 204A Theory and Musicianship Lab III (1 credit hours)
As a continuation of MUS 154 (Theory and Musicianship Lab II), this course examines compositional processes in chromatic harmony and musical form. Students acquire fluency in the aural comprehension of these processes through rhythmic, melodic, and harmonic dictation; contextual listening and identification; composition; sight-singing; and rhythm-reading. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 154 (Theory and Musicianship Lab II); Corequisite: MUS 203 either before or simultaneously with MUS 204
Typically offered in Fall only

MUS 206 America's Music (3 credit hours)
Historical survey of music in the United States, including classical and popular, secular and religious, vocal and instrumental music genres and styles from the 18th to 21st centuries, studied in the context of relevant social and cultural issues. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

MUS 207 Class Piano II (1 credit hours)
The study and performance of intermediate piano repertoire.

Prerequisite: MUS 107
Typically offered in Fall and Spring

MUS 208 Piano Pedagogy (2 credit hours)
This course is designed to prepare students to teach piano at the elementary level. Topics discussed are the history of piano pedagogy; principles of pedagogy; age- and level-based learning types; technical, artistic and performance problems; music pedagogy as career; reference and teaching materials; and introduction in MIDI technology. Requirement for music minors in the piano performance emphasis. Prerequisite: MUS 390, 207, or instructor's consent.

Prerequisite: MUS 390 or MUS 207; C: MUS 390
Typically offered in Spring only

MUS 210 Introduction to Popular Music: 1950s-1970s (3 credit hours)
This course examines the stylistic evolution and cultural impact of popular music in the United States from the 1950s through the 1970s. Musical styles discussed include American and British rock, R&B, country, folk, soul, funk, reggae, disco, and punk. No prior musical knowledge is necessary. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. This course fulfills GEP requirements in Visual and Performing Arts.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall and Summer

MUS 211 Introduction to Popular Music: 1980s-Present (3 credit hours)
The course examines the stylistic development and cultural impact of popular music in the United States from the 1980s to the present. Musical styles discussed include mainstream and alternative rock, metal, pop, country, contemporary R&B, rap, hip-hop, dance music, and electronica. No prior musical knowledge is necessary. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event. This course fulfills GEP requirements in Visual and Performing Arts.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 230/AFS 230 Introduction to African-American Music (3 credit hours)
Comprehensive survey of African-American music in the United States from Colonial times to the present, with emphasis on its unique features and contributions to American culture.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 231 Music in Film and Television (3 credit hours)
This course is a survey of the history and the change over time in film and TV scores from the Silent Era until the present. It is an introduction to the interlocking studies of film, music, literature, politics, and culture in the United States in the twentieth and twenty-first centuries. Students will learn how music enhances, comments on, undermines, and directs a viewer's interpretation of a film or TV episode. Different film genres including horror, historical fiction, movie musicals, and speculative fiction will be highlighted in the course content. Through class discussions, class activities, formal, and informal writing assignments, students will evaluate films, sound recordings, scholarly publications, and primary sources about music in film. No previous musical experience is required.

GEP Humanities

MUS 240 Introduction to the Music Industry (3 credit hours)
This course provides an introduction to the commercial music industry, including its history and development in the context of multiple popular and traditional genres in the United States. Introduction to the Music Industry will increase a student's understanding of common business practices and related knowledge concerning the music industry. It will also assist those students considering further study of the music industry to effectively maintain a professional music career. Students may be required to provide their own transportation to and cover the cost of on- and off-campus events.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 253 Theory and Musicianship IV (3 credit hours)
As a continuation of MUS 203 (Theory and Musicianship III), this course examines compositional processes in 20th- and 21st-century music. Students acquire fluency in the written comprehension of these processes through analysis, problem solving, and notation. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 203A (Theory and Musicianship III); Corequisites: MUS 254 either after or simultaneously with MUS 253
Typically offered in Spring only

MUS 254 Theory and Musicianship Lab IV (1 credit hours)
As a continuation of MUS 204 (Theory and Musicianship Lab III), this course examines compositional processes in 20th- and 21st-century music. Students acquire fluency in the aural comprehension of these processes through rhythmic, melodic, and harmonic dictation; contextual listening and identification; composition; sight-singing; and rhythm-reading. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus musical event not to exceed $20.

Prerequisite: MUS 203A (Theory and Musicianship III); Corequisite: MUS 253 either before or simultaneously with MUS 254
Typically offered in Spring only

MUS 260/AFS 260 History of Jazz (3 credit hours)
History of jazz and the contributions of major artists. Emphasis of the various styles that have contributed to this American art form. Investigation of structural forms in the jazz idiom.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring and Summer

MUS 270 Songwriting using Digital Audio Workstations (2 credit hours)
A class specifically for songwriters, musicians, beat makers, sample manipulators and scratch artists using digital audio workstations (DAWs) as composition tools. This course will also introduce basic audio engineering, gain structure, and signal flow from interface to DAW. The goal is to explore the broader DAW platform as a tool in the songwriting process. Students will explore editing, looping, effects, equalization, plugins and rack hardware. No specific prior mathematics, engineering, or computer training required. Students may be asked to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 293 Applied Music Lessons II (1 credit hours)
Designed for the second two semesters of a four-semester program of study, this course offers individual instruction in voice or instrumental performance that includes the development of basic technique as well as the advancement of artistry, musicianship, and repertoire. An end-of-semester performance jury serves as a measure of progress for continuation of applied study. A lesson charge of $300.00 is assessed at the beginning of each semester. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: Music Minors only; two semesters of MUS 193 or departmental approval.

Requisite: Music Minors Only and Two Semesters of MUS 193 or Departmental Approval
Typically offered in Fall and Spring

MUS 295 Special Topics in Music (1-3 credit hours)
Special Topics in Music

MUS 300 Chamber Music Performance (1 credit hours)
Performance of chamber music. Emphasis on chamber literature from the sixteen through the twentieth centuries written for a wide variety of combinations ranging from string quartets to pieces written for specific instruments and voices.

Prerequisite: Satisfactorily passing audition
Typically offered in Fall and Spring

MUS 305 Music Composition (3 credit hours)
Study and creation of musical works. Emphasis on writing original music and works imitative of conventional and contemporary musical styles. Students may have to provide their own transportation to an on- or off-campus event and to cover the cost of that event.

Theory I (MUS 103) or consent of instructor
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 306/ARS 306 Music Composition with Computers (3 credit hours)
Survey of the theory and history of computer music, compositional algorithms, digital synthesis techniques, composition of at least one computer music work -- a computer-assisted composition for traditional instruments, a piece for computer music on tape, a real-time piece, or a piece that combines tape and instrument(s).

Prerequisite: Some knowledge of music or computer science (e.g. CSC 200)
GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 310 Music of the 17th and 18th Centuries (3 credit hours)
Evolution of European music from 1600 to 1820, with emphasis on characteristics of Baroque and Classical form and style. Examination of major composers and representative works in light of social, political and cultural influences. Students may be required to attend an on- or off-campus event at their own cost and to provide their own transportation.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 315 Music of the 19th Century (3 credit hours)
A survey of 19th century European music, including analysis of its texts, forms and composers, and its relations to other art forms of the period. This course fulfills GEP categories in Visual and Performing Arts and Global Knowledge. Students may be required to attend an on- or off-campus musical event at their own cost and to provide their own means of transportation.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall and Spring

MUS 320 Music of the 20th Century (3 credit hours)
This course is a study of Western Art Music from 1900 to the present, emphasizing significant composers, repertoire, and compositional procedures and trends, including traditional, atonal, serial, aleatoric, electronic and computer music. The ability to read music is not required. Students may be required to attend and cover the cost of an on-campus event. This course fulfills GEP categories in Visual and Performing Arts and Global Knowledge.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 330 Survey of Musical Theater (3 credit hours)
Survey of staged musical works spanning four centuries. Emphasis on large-scale dramatic works in the genres of opera, operetta, and musical. Designed for students with musical and/or theatrical experience. Students may be required to provide their own transportation to and cover the cost of an on- or off-campus event.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 350 Music of Asia (3 credit hours)
Examination of music from a variety of Asian traditions including India and Pakistan, Japan and Korea, Thailand and Indonesia. Emphasis place on philosophical, social and religious contexts from which music emerges and in which it is experienced bynative performers and listeners. No previous formal training in music in required.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall only

MUS 360/WGS 360 Women In Music (3 credit hours)
The role of women in music as patrons, teachers, composers, and performers, placing them within the social, economic, and political framework to which they belong. Emphasis on Western Art Music and the role of women in popular music. No previous formal training in music is required.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

MUS 370 Intermediate Songwriting using Digital Audio Workstations (2 credit hours)
This class is designed for intermediate songwriters, musicians, beat makers, sample manipulators, and scratch artists using digital audio workstations (DAWs) as composition tools. Intended as a continuation of MUS 270, this course provides intermediate audio engineering and applied technical knowledge, such as equalization, compression, digital signal processing and mixing. Weekly assignments demonstrate command of the sonic and technical aspects of digital audio as well as the craft of songwriting. Students may be asked to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: MUS 270 or departmental approval.

Prerequisite: MUS 270 or Departmental approval
Typically offered in Fall and Spring

MUS 393 Recital (1 credit hours)
The recital is the capstone for students in the Music Minor performance concentration. Students receive weekly individual instruction culminating in a public solo recital. Students also receive instruction in organizing the recital. A lesson charge of $300.00 is assessed at the beginning of the semester. Pending departmental approval, this course may be taken for up to two semesters for credit. Students may be required to provide their own transportation to and cover the minimal cost of an on- or off-campus event. Prerequisite: two semesters of MUS 293 or departmental approval.

Prerequisite: two semesters of MUS 293 or departmental approval
Typically offered in Fall and Spring

MUS 495 Special Topics in Music (3 credit hours)
Examination of selected topics in music.

Typically offered in Fall and Spring

MUS 498 Independent Study in Music (1-3 credit hours)
Directed independent study of selected topics for students with specialized interests in music and/or advanced musical ability. Credit and content determined by faculty member in consultation with Director of Music. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Natural Resources (NR)

NR 203/PRT 203/IDS 203 Humans and the Environment (3 credit hours)
Solutions-focused examination of the varied, complex, and evolving frameworks used to make sense of how individuals & societies connect with the biophysical environment. Emphasis on current issues and relevance of interdisciplinary training to careers including environmental planning and policy, sustainable tourism, parks and recreation management, conservation, environmental education, and climate resilience. Topics include: population dynamics, public land and common resources, renewable natural resources, pollution, water resources, energy and non-renewable resources.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

NR 219 Natural Resource Markets (3 credit hours)
A brief overview of financial markets relevant to natural resources and real assets. An introduction to traditional and non-traditional markets including timber markets, carbon and bioenergy markets, conservation banking, and wetland and stream mitigation credits. Investment analysis criteria and market and non-market valuation of natural resources.

GEP Social Sciences
Typically offered in Spring only

NR 293 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

NR 294 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

NR 295 Special Topics in Natural Resources (1-3 credit hours)
Special Topics in Natural Resources at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

NR 300 Natural Resource Measurements (4 credit hours)
Theory and practice of measuring, analyzing, and describing the characteristics of natural ecosystems. Surveying and mapping, inventory of vegetation, soils, wildlife habitat, and hydrology. Sampling, data analysis, and presentation of data. Use of geographic information systems to store, analyze, and present environmental data. Intensive instruction and practice in communication of technical information

Prerequisite: (PB 360 or BIO 360) and ST 311
Typically offered in Spring only

NR 301 Practicum for Professional Development I (1 credit hours)
Instruction in professional report writing and presentation, resume preparation and interview skills, professional ethics and practices, job searching skills; review and critique of professional seminars and documents from NR 301 students; preparation for summer work experience.

Prerequisite: Junior standing, NR Majors
Typically offered in Fall only

NR 350 International Sustainable Resource Use (4 credit hours)
Study of sustainable use of natural resources in a global economy with consideration of consumption choices, sustainable production issues, conservation of various managed landscapes, and cross cultural perspectives. Specific topics vary somewhat byyear and study location. Travel in North America in even years and to Sweden in odd years. Domestic or international travel overnight. Depending upon travel location, possible additional expense for passport, health certificate, insurance and domestic or international travel.

Prerequisite: Sophomore standing
Typically offered in Summer only

NR 360 Internship Experience (3 credit hours)
Internship experience with a natural resource agency or company. Most internships require working and living off-campus. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: NR 301 and Junior standing
Typically offered in Fall, Spring, and Summer

NR 400/NR 500 Natural Resource Management (4 credit hours)
Theory and practice of integrated natural resource management. Quantitative optimization, economics of multiple-use, compounding and discounting, optimal rotations, linear programming. Public and private management case studies and team projects.

Prerequisite: Senior standing in NR or ES or ETM or FOM or FWCB
Typically offered in Spring only

NR 406 Conservation of Biological Diversity (3 credit hours)
Population biology concepts fundamental to understanding the properties of the objects of conservation. Genetic diversity in agriculture, forestry, and animal breeding; the ethical and international policy issues in preservation and management.

Prerequisite: Junior standing
GEP Interdisciplinary Perspectives
Typically offered in Fall only

NR 420/FOR 520/NR 520/FOR 420 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

NR 421/NR 521 Wetland Assessment, Delineation and Regulation (3 credit hours)
Wetland definitions and systems of classification and functional assessment; methods for assessing ecological functions of wetlands; identification and delineation of jurisdictional wetlands in accordance with US Army Corps of Engineers procedures; application of federal and state regulatory programs. Five Saturday field trips are required. Credit will not be given for both NR 421 and NR 521

Prerequisite: SSC 200, (PB 360 or BIO 360), and (FOR 339 or PB 405)
Typically offered in Spring only

NR 460/NR 560 Renewable Natural Resource Management and Policy (3 credit hours)
The interaction of legal principles and governmental institutions in the development and implementation of natural resource policy and management. Legal principles, constitutional provisions and the location and organization of governmental programs. Examples from both historic and current case studies.

Prerequisite: Junior standing.
GEP Social Sciences
Typically offered in Fall only

NR 484 Environmental Impact Assessment (4 credit hours)
Impact assessment principles, practices, and their evolution. Lectures and field practicums concerning problems addressed by environmental assessment practitioners. Practical implications of current regulatory requirements, especially endangered species and wetlands.

Prerequisite: Senior standing
Typically offered in Fall only

NR 491/FOR 491 Special Topics in Forestry and Related Natural Resources (1-4 credit hours)
Independent (or group) study or research of a forestry or related natural resources topic with a faculty supervisor of the student's choice. Also courses offered on a trial basis.

Typically offered in Fall and Spring

NR 493 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the advanced level developed under the direction of a faculty member. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

NR 494 Independent Study in Natural Resources (1-6 credit hours)
Independent Study for Natural Resources students at the advanced level developed under the direction of a faculty member. Individualized/ Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

NR 500/NR 400 Natural Resource Management (4 credit hours)
Theory and practice of integrated natural resource management. Quantitative optimization, economics of multiple-use, compounding and discounting, optimal rotations, linear programming. Public and private management case studies and team projects.

Prerequisite: Senior standing in NR or ES or ETM or FOM or FWCB
Typically offered in Spring only

NR 510 Military Land Sustainability (3 credit hours)
An introduction and overview of the factors that influence natural resource conservation and management on Department of Defense lands within a temporal, geographic, and environmental context and perspective. Students will gain knowledge of natural resource management and military land sustainability by reviewing (1) military land uses and training/test requirements, (2) major policies/laws impacting training/testing activities on DoD lands, and (3) planning approaches to military sustainability.

Typically offered in Fall only

NR 511 Managing Natural Resources in an Arena of Conflict (3 credit hours)
Public policy issues, such as management of natural resources, are pervasive with conflicts. Surpassing political, jurisdictional, institutional, and geographic boundaries, natural resources and environmental issues can represent multiple dimensions of uncertainties and complexities. Effective management of public issues then is an important task (and topic) for natural resource professionals who are often required to develop management strategies to resolve or at best, reduce the level of the conflict. This course examines theories and approaches for managing natural resource conflict, with emphasis on the field of public or alternative dispute resolution (ADR) and its spectrum of collaborative approaches. Undergraduate degree or instructor approval required.

Typically offered in Fall only

NR 512 Land Use Policy & Management (3 credit hours)
Graduate course reviewing the history, formation and implementation of major natural resource laws and policies that impact land uses. This course will provide an overview of federal laws and policies that affect decision making by land managers. Weekly lectures will be followed by student presentations of a selected case study of their choosing in the final weeks of the course. Current natural resource / land management (including forestry, air, water, wildlife, climate change and energy) programs and institutions are discussed, analyzed and related to current land use and management policy challenges.

Restriction: undergraduate degree or instructor approval
Typically offered in Spring only

NR 520/FOR 420/NR 420/FOR 520 Watershed and Wetlands Hydrology (4 credit hours)
Principles of hydrologic science; classification and assessment of watersheds and stream networks; hydrologic, erosion, and water quality processes in natural and managed watersheds; wetlands hydrology; hydrologic measurements and data analysis; applications of hydrology and water quality management for forest agriculture, and urban ecosystems; watershed restoration. Emphasis field study of watersheds and hydrologic measurements. Two weekend field trips are required. Credit will not be given for both FOR(NR)420 and FOR(NR)520.

Prerequisite: SSC 200 and (FOR 260 or PB 360 or AEC 360)
Typically offered in Fall only

NR 521/NR 421 Wetland Assessment, Delineation and Regulation (3 credit hours)
Wetland definitions and systems of classification and functional assessment; methods for assessing ecological functions of wetlands; identification and delineation of jurisdictional wetlands in accordance with US Army Corps of Engineers procedures; application of federal and state regulatory programs. Five Saturday field trips are required. Credit will not be given for both NR 421 and NR 521

Prerequisite: SSC 200, (PB 360 or BIO 360), and (FOR 339 or PB 405)
Typically offered in Spring only

NR 548 Historical Environments (3 credit hours)
Course examines how we know and what we know about historical environments. Compares and contrasts contributions by various disciplines and interdisciplinary approaches to historical ecology and environmental history. Readings drawn from science, social science and humanities literature. Individual investigation projects required.

Typically offered in Spring only

NR 554 Introduction to Data Analysis in Natural Resources (3 credit hours)
Data examination, cleaning, summary and visualization, statistical analyses options using various procedures of the SAS software and R with an emphasis on natural resource applications. Interpretation of statistical analyses outputs. Discussions of individual data problems. Hands-on use of computers and the SAS and R software.

Pre or Co-requisite of ST512
Typically offered in Spring only

NR 560/NR 460 Renewable Natural Resource Management and Policy (3 credit hours)
The interaction of legal principles and governmental institutions in the development and implementation of natural resource policy and management. Legal principles, constitutional provisions and the location and organization of governmental programs. Examples from both historic and current case studies.

Prerequisite: Junior standing.
GEP Social Sciences
Typically offered in Fall only

NR 571 Current Issues in Natural Resource Policy (3 credit hours)
Seminar providing an overview of current natural resource issues for the world and the U.S. Population, sustainable development, food and agriculture, forests, rangelands, biodiversity, energy resources, water resources, atmosphere and climate, international policies and instructions.

Typically offered in Fall only

NR 595 Special Topics in Natural Resources (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore natural resources related topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems, or research not related to thesis. Also used to develop and test new 500-level courses.

Typically offered in Fall and Spring

NR 601 Graduate Seminar (1 credit hours)
Weekly seminar in which students registered for course present the results of research and special projects. Invitation to all graduate students and faculty in department to attend and join discussion.

Typically offered in Fall and Spring

NR 610 Special Topics in Natural Resources (1-6 credit hours)
Individual students or groups of students, under direction of a faculty member, may explore natural resources related topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems, or research not related to thesis. Also used to develop and test new 600-level courses.

Typically offered in Fall and Spring

NR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NR 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

Natural Sciences (NSGE)

NSGE 295 Natural Sciences Special Topics (1-4 credit hours)
Special topics course offering for the general education Natural Sciences category.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

Natural Sciences and Global Knowledge (NSGK)

NSGK 295 Natural Sciences and Global Knowledge Special Topics (3 credit hours)
Special topics course offering for the general education Natural Sciences and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Natural Sciences (NS) requirement.

GEP Global Knowledge, GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

Naval Science (NS)

NS 100 Naval Science Lab (0 credit hours)
Military drill, courtesies and honors, elements of unit leadership, physical fitness and professional development of the prospective Naval/Marine Corps Officer. Required for all Naval ROTC students.

Typically offered in Fall and Spring

NS 110 Introduction to Naval Science (2 credit hours)
Fundamental orientation to the Naval Service emphasizing the mission, organization, regulations, customs and traditions, broad warfare components of Navy and the major challenges facing today's Navy and Marine Officers.

Typically offered in Fall only

NS 210 Leadership and Management (3 credit hours)
Assists students in acquiring knowledge and developing the cognitive processes necessary to make decisions in the practice of management. The student will learn the traditional foundations of management while developing decision skills to apply this knowledge in a real-world setting. The major focus is centered upon global management, ethics and social responsibility, total quality management, and cultural diversity.

GEP Social Sciences
Typically offered in Fall only

NS 225 Navigation (4 credit hours)
A broad yet thorough education in basic ship navigation. Course includes a study of various navigation methods, weather, the laws of the sea, and navigational rules. Practical work includes chart plotting and understanding relative motion.

Typically offered in Spring and Summer

NS 315 Naval Engineering (3 credit hours)
Introduction to the application of engineering principles in the research, development, design, construction, and operation of ships, weapons systems, and ocean structures, with emphasis on thermodynamic processes and energy conversions.

Typically offered in Spring only

NS 325 Naval Weapons Systems (3 credit hours)
An introduction to the concepts and properties of electronic, physical, electromagnetic and mechanical systems to foster an understanding of the theory and principles of operation of shipboard weapons systems, course emphasizes types of weapons and fire control systems, capabilities and limitations, theory of target acquisition, identification and tracking, trajectory and ballistics principles, and basic theory of radar and sonar.

Typically offered in Fall only

NS 330 Evolution of Warfare (3 credit hours)
A survey of the evolution of warfare through the study of selected campaigns and classic battles with special emphasis on the principles of war, the military impact of leadership, and the evolution of tactics, weapons, and weaponry.

Typically offered in Spring only

NS 415 Naval Operations (4 credit hours)
A thorough exploration of the operations conducted by the U.S. Navy. Course includes a study of U.S. Naval evolutions, operations, command & control, communication, and an introduction to naval warfare doctrine. Practical applications include the determination of advanced maneuvering methods through and in-depth understanding of relative motion.

Prerequisite: NS 225 Navigation
Typically offered in Fall only

NS 420 Naval Leadership and Ethics (3 credit hours)
An intellectual exploration of Western moral traditions and ethical philosophy with a variety of topics, such as military leadership, core values, and professional ethics; the Uniform Code of Military Justice and Navy Regulations; and discussions relating to the roles of enlisted members, junior and senior officers, command relationships, and the conduct of warfare. The course provides students with a foundation of moral traditions, combined with a discussion of actual current and historical events in the United States navy and Marine Corps, to prepare them for the role and responsibilities of leadership in the naval service of the 21st century.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

NS 430 Amphibious Warfare (3 credit hours)
A survey of the projection of sea power ashore with special emphasis on the evolution of and innovation in amphibious warfare in the 20th Century through the study of historical amphibious landings and campaigns.

Typically offered in Spring only

NC Global Training Initiative (GTI)

GTI 401 US Culture and Education Colloquium (3 credit hours)
Overview of US Culture, Higher Education in America, and Student Success Skills for degree or non-degree international students. Guest faculty lectures, media presentations, field trips, and required readings form basis for discussiong roups, assignments, and capstone paper (refleciton on issues discussed in class, personal development, and required community involvment). Includes break-out discussion groups, field trips, personal projects and research. Students may have additional travel cost associated with field trips. Enrollment limited to first year international students, participants in NC Global Training Initiative Certificate Programs, or by permission of the instructor.

Typically offered in Fall only

Nonprofit Studies (NPS)

NPS 340 Fundamentals of Grant Development for Nonprofits (3 credit hours)
The focus of this class is on obtaining grant funding for nonprofit organizations. This course covers the skills and strategies essential to the grants development process including basic strategies for researching funding sources and developing successful grant proposals.

Typically offered in Spring only

NPS 395 Special Topics in Nonprofit Studies (1-6 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings or for offering of new courses on a trial basis.

NPS 490 Service Learning Internship in Nonprofit Studies (3 credit hours)
The 150 hour (3 credit hour) online service learning internship course provides students with the opportunity to apply the knowledge, skills, and abilities gained through their coursework in the Nonprofits Studies Minor to a nonprofit organizational work setting. The online course builds on previous coursework in the minor and focuses learning from these courses on application to a service learning work setting by requiring students to reflect on the applicability of the Five Leadership Challenges studied throughout the minor to their real work experience. Students are expected to be active participants in work place discussions, lending expertise, ideas and knowledge from their course work to the organizations and their leaders.

Prerequisite: PS 203 and COM 466 and HI 380. Restricted to Nonprofit Studies Minor Students Only.
Typically offered in Fall, Spring, and Summer

NPS 498 Capstone Seminar in Nonprofit Studies (1 credit hours)
This capstone seminar integrates the knowledge, skills, and abilities gained through coursework in the minor in Nonprofit Studies through class discussions and reflective writings where students draw upon previous service-learning experiences to reflect on challenges facing nonprofit leaders. Case studies and articles that focus on the themes of the minor are used to stimulate class discussions. Nonprofit leaders serve as discussants. In addition, students complete and submit a Nonprofit Studies portfolio, which documents successful achievement of program objectives. Departmental approval required

Prerequisite: PS 203, COM 466, Corequisite: NPS 490
Typically offered in Fall and Spring

Nonwovens (NW)

NW 404/TT 404/TT 504/NW 504 Introduction to Nonwovens Products and Processes (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.

Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall only

NW 405/TT 405/TT 505/NW 505 Advanced Nonwovens Processing (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.

Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206) , TT 305 or TT 404
Typically offered in Spring only

NW 408/TT 408/TT 508/NW 508 Nonwoven Product Development (3 credit hours)
Fundamentals of nonwoven product development. In-depth knowledge of the materials, processes and nonwovens products. Design of a set of experiments intended for product development. Students work in teams to design, fabricate and evaluate nonwoven products.

Prerequisites: TT 405 and TT 407
Typically offered in Spring only

NW 497 Research Experience in Nonwoven Science and Technology (3 credit hours)
This course provides an opportunity for students to gain real-world experiences in nonwoven science and technology relevant to their academic and career goals. The course is designed to provide an academic framework for the student to learn through a nonwoven research experience and/or exploration of nonwoven industry operations while integrating their academic program experience under a faculty mentor's supervision.

P: TT404
Typically offered in Fall, Spring, and Summer

NW 503/TT 503 Materials, Polymers, and Fibers used in Nonwovens (3 credit hours)
Fundamentals of raw material used in nonwoven processes. Raw material production, chemical and physical properties of nonwoven raw materials and assessment of material properties. Introduction of structure/property relationships for these materials and how these relationships influence end use applications.

Prerequisite: MA 141, PY 205, PCC 203
Typically offered in Fall and Spring

NW 504/NW 404/TT 404/TT 504 Introduction to Nonwovens Products and Processes (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.

Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall and Spring

NW 505/NW 405/TT 405/TT 505 Advanced Nonwovens Processing (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.

Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206) , TT 305 or TT 404
Typically offered in Spring only

NW 506 Bonding Principles in Nonwovens (3 credit hours)
Fundamentals of fluid mechanics and heat transfer mechanisms during the bonding nonwovens. Provide engineering and in-depth description of hydroentangling, thermal bonding and needle punching techniques. Modeling methods and laboratory work are assigned.

Prerequisite: MAE 308, MAE 310, TT /NW505
Typically offered in Fall and Summer

NW 507/TT 507 Nonwoven Characterization Methods (3 credit hours)
Fundamentals of methods used in evaluating properties and performance of nonwovens. Assessment of thermal, mechanical, moisture transport and barrier properties of nonwovens. Reliability and interpretation of test results.

Prerequisite: ST 361, Corequisite: TT/NW 505
Typically offered in Spring only

NW 508/NW 408/TT 408/TT 508 Nonwoven Product Development (3 credit hours)
Fundamentals of nonwoven product development. In-depth knowledge of the materials, processes and nonwovens products. Design of a set of experiments intended for product development. Students work in teams to design, fabricate and evaluate nonwoven products.

Prerequisites: TT 405 and TT 407
Typically offered in Fall and Spring

Nuclear Engineering (NE)

NE 201 Introduction to Nuclear Engineering (2 credit hours)
An introduction to the concepts, systems and application of nuclear processes. Topics include radioactivity, fission, fusion, reactor concepts, biological effects of radiation, nuclear propulsion, and radioactive waste disposal. Designed to give students a broad perspective of nuclear engineering and an introduction to fundamentals and applications of nuclear energy.

Prerequisite: Grade of C or better in MA 241, PY 205
Typically offered in Fall only

NE 202 Radiation Sources, Interaction and Detection (4 credit hours)
Introduction to nuclear energy. Topics include radioactivity, radiation detection, interaction of radiation with matter, nuclear reactions, fission, fusion, nuclear reactors, radiation safety and protection, and laboratory measurement of nuclear radiation.

Prerequisites: C- or better in MA 242 and PY 208
Typically offered in Spring only

NE 235 Nuclear Reactor Operations Training (2 credit hours)
Principles of nuclear reactor operations. Lectures to cover basic nuclear engineering theory pertaining to fission reactor operations; laboratory sessions to provide hands on training with the PULSTAR nuclear reactor including facility pre-startup checks, approach to criticality, steady state operations, and measurement of various operating parameters. Qualified students may opt to enter training and study for the U.S. Nuclear Regulatory Commission exam to become federally licensed nuclear Reactor Operators. Does not count towards NE graduation requirements

Typically offered in Fall only

NE 290 Introduction to Health Physics (3 credit hours)
Fundamentals of ionizing radiation safety. The course will review basic physical principles, radiation sources, introductory radiation dosimetry, radiation safety guidelines, evaluation of safety measures, and basic radiation control principles for contamination and radioactive material safety to include measurement physics, counting statistics and basic radiobiology principles.

Prerequisite: MA 111 or MA 108 with grade of C- or better, or 550 or better on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calculus exam.
GEP Interdisciplinary Perspectives, GEP Natural Sciences
Typically offered in Fall only

NE 301 Fundamentals of Nuclear Engineering (3 credit hours)
Introductory course in nuclear engineering. Neutron physics, reactor operation, and reactor dynamics. Basic principles underlying the design and operation of nuclear systems, facilities and applications.

Prerequisite: MA 341 and (CSC 112 or CSC 113) and C- or better in NE 202
Typically offered in Fall only

NE 400 Nuclear Reactor Energy Conversion (4 credit hours)
Introduction to the concepts and principles of heat generation and removal in reactor systems. Power cycles, reactor heat sources, analytic and numerical solutions to conduction problems in reactor components and fuel elements, heat transfer in reactor fuel bundles and heat exchangers. Problem sets emphasize design principles. Heat transfer lab included. Credit will not be given for both NE 400 and NE 500.

Prerequisite: MAE 201 and a C- or better in NE 301
Typically offered in Spring only

NE 401/NE 501 Reactor Analysis and Design (3 credit hours)
Elements of nuclear reactor theory for reactor core design and operation. Includes one-group neutron transport and mutigroup diffusion models, analytical and numerical criticality search, and flux distribution and calculations for homogeneous and heterogeneous reactors, slowing down models, introduction to perturbation theory.

Prerequisites: MA 401 and C- or better in NE 301
Typically offered in Spring only

NE 402 Reactor Engineering (4 credit hours)
A course in thermal-hydraulic design and analysis of nuclear systems. Single and two-phase flow, boiling heat transfer, modeling of fluid systems. Design constraints imposed by thermal-hydraulic considerations are discussed. A thermal-hydraulics laboratory included. Credit will not be given for both NE 402 and NE 502.

Prerequisite: MAE 308 and either NE 400 or MAE 310
Typically offered in Fall only

NE 403 Nuclear Reactor Laboratory (2 credit hours)
Nuclear reactor laboratory. A laboratory course performed on the NCSU PULSTAR reactor. Topics include reactor startup and approach to critical. Neutron flux distributions. Reactivity balances. Control rod worth and power coefficients of reactivity.

Prerequisite: C- or better in NE 301 Co-requisite: NE 401
Typically offered in Spring only

NE 404 Radiation Safety and Shielding (3 credit hours)
Radiation safety and environmental aspects of nuclear power generation. Radiation interaction, photon attenuation, shielding theory and design project, external and internal dose evaluation, reactor effluents and release of radioactivity into the environment, transportation and disposal of radioactive waste; and environmental impact of nuclear power plants.

Prerequisite: NE 301 with a grade of C- or better or NE 419
Typically offered in Fall only

NE 405 Reactor Systems (3 credit hours)
Nuclear power plant systems: design criteria, design parameters, and economics. Topics covered include: PWR, BWR, core design, primary loops, auxiliary and emergency systems; containment, reactor control and protection systems, accident and transient behaviors.

Prerequisite: NE 401, NE 402
Typically offered in Spring only

NE 406 Nuclear Engineering Senior Design Preparation (1 credit hours)
Preliminary design phase in nuclear engineering systems to prepare for the final phase design. Preliminary designs developed by teams with advice of faculty, with reports presented in oral and written form. Current and future systems emphasized, and use of computers encouraged.

Prerequisite: NE 401, Corequisite: NE 402
Typically offered in Fall only

NE 408 Nuclear Engineering Design Project (3 credit hours)
Projects in design of practical nuclear engineering systems. Preliminary designs developed by teams with advice by faculty as needed, with reports presented in oral and written form. Current and future systems emphasized, and use of computers encouraged.

Prerequisite: NE 406
Typically offered in Spring only

NE 409/MSE 409/NE 509/MSE 509 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.

Prerequisite: MSE 201
Typically offered in Fall only

NE 412 Nuclear Fuel Cycles (3 credit hours)
Processing of nuclear fuel with descriptions of mining, milling, conversion, enrichment, fabrication, irradiation, reprocessing, and waste disposal. In-core and out-of-core nuclear fuel management design, including objectives, constraints, decisionsand methodologies. Nuclear power plant and fuel cycle economics.

Prerequisite: NE 401
Typically offered in Fall only

NE 418 Nuclear Power Plant Instrumentation (3 credit hours)
Instrumentation and supporting systems required for control and protection of a nuclear power plant. Radiation measurement, process measurement, and reactor operating principles used to develop instrumentation requirements and characteristics. Requirements and implementations of instrumentation, control and protection systems for pressurized and boiling water reactors. Design and implementation issues include power supplies, signal transmission, redundancy and diversity, response time, and reliability.

Prerequisite: ECE 221 or ECE 331
Typically offered in Spring only

NE 419 Introduction to Nuclear Energy (3 credit hours)
Electrical power generation from nuclear fission, fundamental aspects of fission chain reaction, and reactor design. Reactor types, their static and dynamic characteristics and instrumentation. Reactor operation and safety. Nuclear fusion and fusionreactor development.Not open to majors in Nuclear Engineering

Prerequisite: PY 202 or PY 208
Typically offered in Fall and Spring

NE 431/NE 531 Nuclear Waste Management (3 credit hours)
Scientific and engineering aspects of nuclear waste management. Management of spent fuel, high-level waste, uranium mill tailings, low-level waste and decommissioning wastes. Fundamental processes for the evaluation of waste management systems with emphasis on the safety assessment of waste disposal facilities to include nuclear criticality safety, free release and transportation. There is also a required research project for the graduate version of the course.

Prerequisite: MA 341 and PY208 (or any equivalent)
Typically offered in Fall only

NE 460 Probabilistic Risk Assessment and Management of Nuclear Systems (3 credit hours)
A course which introduces principles of probabilistic risk assessment and management of complex engineering systems, with a particular focus on nuclear power applications. Fundamental safety and risk concepts, accidents and risk management, a review of major probabilistic risk assessment studies, hazard analysis, qualitative and quantitative systems analysis, human and software reliability, uncertainty quantification, and risk-informed and performance-based design and licensing of advanced nuclear reactors under development. Risk and safety principles are emphasized in homework and in-class problems. Course project is required. Credit will not be given for both NE 460 and NE 560.

Typically offered in Fall only

NE 490/NE 590 Health Physics and Radiological Emergency Response (3 credit hours)
This is an advanced health physics course encompassing internal and external radiological dosimetry along with control of radiation fields including airborne radioactivity. Students will learn basic interactions and response functions, biological effects as well as natural and manmade sources allowing emphasis on the final coverage of nuclear emergency response.

Prerequisite: MA 341 and PY 208 (or equivalent)
Typically offered in Fall only

NE 491 Special Topics in Nuclear Engineering (1-4 credit hours)
Detailed coverage of special topics.

NE 500 Advanced Energy Conversion in Nuclear Reactors (3 credit hours)
A course which introduces concepts and principles of heat generation and removal in reactor systems. Power cycles, reactor heat sources, analytic and numerical solutions to conduction problems in reactor components and fuel elements, heat transfer in reactor fuel bundles and heat exchangers. Design principles are emphasized in homework and in-class problems. Course project is required. Credit will not be given for both NE 400 and NE 500.

Prerequisite: MAE 201
Typically offered in Spring only

NE 501/NE 401 Reactor Analysis and Design (3 credit hours)
Elements of nuclear reactor theory for reactor core design and operation. Includes one-group neutron transport and mutigroup diffusion models, analytical and numerical criticality search, and flux distribution and calculations for homogeneous and heterogeneous reactors, slowing down models, introduction to perturbation theory.

Prerequisites: MA 401 and C- or better in NE 301
Typically offered in Spring only

NE 502 Reactor Engineering (3 credit hours)
Thermal-hydraulic design and analysis of nuclear systems. Single and two-phase flow, boiling heat transfer, modeling of fluid systems. Design constraints imposed by thermal-hydraulic considerations are discussed. Credit will not be given for bothNE 402 and NE 502.

Prerequisite: MAE 308
Typically offered in Fall only

NE 504 Radiation Safety and Shielding (3 credit hours)
A basic course in radiation safety and environmental aspects of nuclear power generation. Topics include radiation interaction, photon attenuation, shielding, internal and external dose evaluation, reactor effluents and release of radioactivity into the environment, transportation and disposal of radioactive waste; and environmental impact of nuclear power plants. Term-long project.

Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 505 Reactor Systems (3 credit hours)
Nuclear power plant systems: PWR, BWR and advanced concepts. Design criteria, design parameters, economics, primary and secondary loops, safety systems, reactor control and protection systems, containment, accident and transient behaviors, core design, and reactivity control mechanisms. Term-long project. Credit for both NE 405 and NE 505 is not allowed

Prerequisite: NE 401, NE 402
Typically offered in Spring only

NE 509/MSE 509/NE 409/MSE 409 Nuclear Materials (3 credit hours)
Introduces students to properties and selection of materials for nuclear steam supply systems and to radiation effects on materials. Implications of radiation damage to reactor materials and materials problems in nuclear engineering are discussed. Topics include an overview of nuclear steam supply systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Students cannot receive credit for both 409 and 509.

Prerequisite: MSE 201
Typically offered in Fall only

NE 512 Nuclear Fuel Cycles (3 credit hours)
Processing of nuclear fuel with description of mining, milling, conversion, enrichment, fabrication, irradiation, shipping, reprocessing and waste disposal. Fuel cycle economics and fuel cost calculation. In-core and out-of-core nuclear fuel management, engineering concepts and methodology. Term-long project. Credit for both NE 412 and NE 512 is not allowed

Prerequisite: NE 401
Typically offered in Fall only

NE 520 Radiation and Reactor Fundamentals (3 credit hours)
Basics of nuclear physics and reactor physics that are needed for graduate studies in nuclear engineering. Concepts covered include, atomic and nuclear models, nuclear reactions, nuclear fission, radioactive decay, neutron interactions, nuclear reactors, neutron diffusion in non-multiplying and multiplying systems, and basic nuclear reactor kinetics.

Prerequisite: MA 341 and PY 208
Typically offered in Fall only

NE 521 Principles of Radiation Measurement (3 credit hours)
Radiation detection measurement methods employed in nuclear engineering. Topics include: physics of nuclear decay and nuclear reactions, interaction of charged particles, photons, and neutrons with matter, fundamental properties of radiation measurement systems, statistical analysis of radiation measurements, common radiation detectors (gas-filled detectors, scintillators, and semiconductor detectors), data acquisition and processing methods, and radiation measurement applications.

Prerequisites: Graduate standing in Nuclear Engineering or instructor permission
Typically offered in Fall only

NE 523 Computational Transport Theory (3 credit hours)
Derivation of the nonlinear Boltzmann equation for a rarefied gas and linearization to the equation of transport of neutral particles. Deterministic methods for solving the neutron transport equation: Multigroup energy discretization; Discrete Ordinates angular discretization; various spatial discretization methods. Convergence of numerical solutions with discretization refinement. Iterative solution algorithms: inner, outer, and power iterations. Spectral analysis of inner iterations convergence and acceleration. Selection of advanced topics.

NE 401/501: Reactor Analysis and Design Advanced math & moderate programming skills are necessary. Permissible programming languages: Fortran or C++
Typically offered in Spring only

NE 528/PY 528 Introduction to Plasma Physics and Fusion Energy (3 credit hours)
Concepts in plasma physics, basics of thermonuclear reactions; charged particle collisions, single particle motions and drifts, radiation from plasmas and plasma waves, fluid theory of plasmas, formation and heating of plasmas, plasma confinement, fusion devices and other plasma applications.

Prerequisite: MA 401 and PY 208
Typically offered in Fall only

NE 529/PY 529 Plasma Physics and Fusion Energy II (3 credit hours)
This course expands on the treatment of plasmas as a system of coupled fluids and introduces the foundations of plasma kinetic theory. Derivation of the plasma kinetic equation and the Vlasov equation serve as the starting point to introduce the kinetic study of plasma systems. From this introduction of the governing equations for full kinetic treatment, methods for analyzing plasma response to electromagnetic and electrostatic perturbations using the linearized Vlasov model for uncorrelated plasmas are introduced. Kinetic stability of Vlasov plasmas is introduced and the Nyquist method is used to determine conditions for kinetic stability. The concept of correlated plasmas is then introduced through the introduction of reduced distribution functions and the BBGKY heirarchy. Finally, simple correlated systems and the Liouville model for two-system correlation is covered to look at the impact of particle correlation due to collisions and coulomb interaction.

Prerequisite: NE 528
Typically offered in Spring only

NE 531/NE 431 Nuclear Waste Management (3 credit hours)
Scientific and engineering aspects of nuclear waste management. Management of spent fuel, high-level waste, uranium mill tailings, low-level waste and decommissioning wastes. Fundamental processes for the evaluation of waste management systems with emphasis on the safety assessment of waste disposal facilities to include nuclear criticality safety, free release and transportation. There is also a required research project for the graduate version of the course.

Prerequisite: MA 341 and PY208 (or any equivalent)
Typically offered in Fall only

NE 533 Nuclear Fuel Performance (3 credit hours)
In this course we will study the basic role of fuel in reactor operation and understand how the fuel impacts heat generation and transport to the coolant. The course will begin with an overview of different fuels and the fabrication processes required to construct nuclear fuel. This will include various fuel types and geometries, with a focus on light water reactor fuel and cladding. Thermal transport, mechanics, and thermomechanics affecting fuel behavior will be introduced, and methods to solve the governing equations numerically and analytically will be developed. Subsequently, changes in the fuel and cladding material that degrade the performance of the fuel will be examined. Finally, the knowledge gained throughout the course will be utilized to conduct fuel performance simulations with MOOSE.

Prerequisite: NE 409 or equivalent
Typically offered in Spring only

NE 541 Nuclear Nonproliferation Technology and Policy (3 credit hours)
Technology and policy challenges and solutions to prevent the spread of nuclear weapons. Topics include: issues of nuclear proliferation inherent to civilian nuclear power development; technologies, processes, and policies for safeguarding nuclear materials and technology; integrating the preceding subjects to strengthen the global nuclear nonproliferation regime. Includes a field trip to Oak Ridge National Laboratory during Spring Break to gain hands-on experience with safeguards measurements of nuclear material. The field trip is required; there is no cost to the student.

Graduate standing in Nuclear Engineering or instructor consent.
Typically offered in Spring only

NE 550 Introduction to Atomistic Simulations (3 credit hours)
NE 550 is an introductory course on molecular dynamics simulations. The course covers the principles of classical and statistical mechanics that underpin the simulation methods. Emphasis is placed on writing computer programs for determining thermodynamic, structural and transport properties of different types of materials.

Typically offered in Spring only

NE 577/MAE 577 Multiscale Two-phase Flow Simulations (3 credit hours)
Modeling and simulation of two-phase flows using interface tracking approach and ensemble averaging approaches. Model validation and verification based on interface-tracking data, boiling models. Nuclear reactor applications. The course focuses on interface tracking methods understanding as applied to bubbly flow simulations. Students will develop a simplified solver to track 2D bubbles/droplets throughout the course homework assignments and will learn how to apply this approach for better understanding of multi-phase flow as part of the course project.

Typically offered in Spring only

NE 590/NE 490 Health Physics and Radiological Emergency Response (3 credit hours)
This is an advanced health physics course encompassing internal and external radiological dosimetry along with control of radiation fields including airborne radioactivity. Students will learn basic interactions and response functions, biological effects as well as natural and manmade sources allowing emphasis on the final coverage of nuclear emergency response.

Prerequisite: MA 341 and PY 208 (or equivalent)
Typically offered in Fall only

NE 591 Special Topics In Nuclear Engineering I (1-6 credit hours)
Credits Arranged

Typically offered in Fall and Spring

NE 592 Special Topics In Nuclear Engineering II (1-6 credit hours)
Credits Arranged

Typically offered in Fall and Spring

NE 601 Seminar (1 credit hours)
Discussion of selected topics in nuclear engineering.

Typically offered in Fall and Spring

NE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NE 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall only

NE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NE 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

NE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NE 721 Nuclear Laboratory Fundamentals (3 credit hours)
Labratory experiments and techniques that are useful and instructive to a Nuclear Engineer. The labs include experiments on radiation detectors and detection techniques, Gamma-and X-ray spectroscopy, and use of the thermal neutron beam of the nuclear reactor for neutron imaging. All state-of-the art radiation detectors are taught and used. Restricted to Nuclear Engineering Graduate Students.

Prerequisite: MA 401 and NE 401
Typically offered in Spring only

NE 722 Reactor Dynamics and Control (3 credit hours)
Methods of describing and analyzing dynamic behavior of systems. These methods applied to reactor systems and the effects of feedbacks studies. Methods of measuring the behavior of reactor systems and development of logic systems for control and safety.

Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 723 Neutron Transport Theory (3 credit hours)
Advanced theory of neutron transport and computational methods of solving particle transport (linear Boltzmann) equation for reactor physics problems. Principle topics: models of neutron transport; analytic methods for solving transport equation; asymptotic diffusion limit; PN and SPN methods, homogenization methodology; numerical methods for multidimensional problems; computational methods for multiphysics problems. Objective is to enable students to read literature and perform relevant analysis of neutron transport and reactor-physics problems.

P:NE 520 or NE 401/501
Typically offered in Fall only

NE 724 Reactor Heat Transfer (3 credit hours)
Consideration of heat generation and transfer in nuclear power reactors. Topics include reactor heat generation, steady-state and transient heat combustion in reactor fuel elements, boiling heat transfer and single and two-phase flow.

Prerequisite: NE 402 and NE 401 or NE 520
Typically offered in Spring only

NE 726 Radioisotopes Measurement Applications (3 credit hours)
Introduction the student to measurement applications using radioisotopes and radiation. Discussion of all major tracing, gauging and analyzer principles and treatment of several specific applications in detail. Objective is to familiarize student with design and analysis of industrial measurement systems using radioisotopes and/or radiation.

Prerequisite: NE 401 or NE 520
Typically offered in Spring only

NE 727 Nuclear Engineering Analysis (3 credit hours)
Fundamental material on: (1) numerical methods for solving the partial differential equations pertinent to nuclear engineering problems, (2) Monte Carlo simulation of radiation transport and (3) data and error analysis techniques including estimation of linear and nonlinear model parameters from experimental data.

Prerequisite: NE 401 or NE 520
Typically offered in Fall only

NE 729 Reactor Theory and Analysis (3 credit hours)
Theoretical aspects of neutron diffusion and transport related to the design computation and performance analysis of nuclear reactors. Principal topics: a unified view of the neutron cycle including slowing down, resonance capture and thermalization; reactor dynamics and control; fuel cycle studies; and neutron transport methods. Background provided for research in power and test reactor analysis.

Prerequisite: NE 723, NE 727
Typically offered in Spring only

NE 732 Principles of Industrial Plasmas (3 credit hours)
Theory and fundamental physical principles of industrial plasmas. Applications in plasma processing, plasma manufacturing technology, arcs and torches, plasma sprayers, high-voltage high-current switching devices, plasma-driven devices and plasma-aided technology. Emphasis on particle transport and plasma flow.

Prerequisite: NE/PY 528
Typically offered in Spring only

NE 740 Laboratory Projects In Nuclear Engineering (3 credit hours)
Enhancement of laboratory skills pertinent to nuclear engineering research through projects that requiring student to design the experiment, assemble equipment, carry out the measurements and analyze and interpret data. Students work in groups of two and perform to completion two laboratory projects.

Prerequisite: NE 721
Typically offered in Spring only

NE 745 Plasma Laboratory (3 credit hours)
Experimental plasma generation and plasma diagnostic techniques. Lecture topics include high vacuum techniques, perturbing and non-perturbing probe techniques, and laser and emission spectroscopy. Laboratories utilize various methods of measuring plasma parameters discussed in lectures.

Prerequisite: NE 528 or PY 508 or PY 509
Typically offered in Spring only

NE 746 Fusion Energy Engineering (3 credit hours)
Description and analysis of the technologies of devices necessary to produce fusion energy including vacuum technology, plasma heating and fueling, magnetics, special energy conversion, neutronics, materials, environment and safety. Stress upon design integration and ensuing technological constraints.

Prerequisite: NE 528
Typically offered in Fall only

NE 751 Nuclear Reactor Design Calculations (3 credit hours)
Application of digital computer to problems in reactor core nuclear design. Study and exercise of available reactor core physics computer modules. Description of systems and programs used by industry for power reactor core design and core follow. A review of relevant analytic and numerical methods facilitates computer program development by students.

Prerequisite: NE 723
Typically offered in Spring only

NE 752 Thermal Hydraulic Design Calculations (3 credit hours)
Advanced presentation of thermal-hydraulic analysis of nuclear power systems. Topics including development of single phase and two-phase fluid flow equations, subchannel analysis, interphase phenomena and numerical solution methods relevant to design and safety analysis codes.

Prerequisite: NE 724
Typically offered in Fall only

NE 753 Reactor Kinetics and Control (3 credit hours)
The control of nuclear reactor systems. Development of basic control theory including the use of Bode, Nyquist and S-plane diagrams and state-variable methods. Analysis of reactor and reactor systems by these methods and development of control methods and optimum-control methods. Discussion of models of reactors and reactor-associated units, such as heat exchangers. Presentation of effects of nonlinearities.

Prerequisite: NE 722
Typically offered in Spring only

NE 755 Reactor Theory and Analysis (3 credit hours)
Theoretical aspects of neutron diffusion and transport related to the design computation and performance analysis of nuclear reactors. Principal topics: a unified view of the neutron cycle including slowing down, resonance capture and thermalization; reactor dynamics and control; fuel cycle studies; and neutron transport methods. Background provided for research in power and test reactor analysis.

Prerequisite: NE 723, NE 727
Typically offered in Spring only

NE 757 Radiation Effects On Materials (3 credit hours)
Interaction of radiation with matter with emphasis on microstructural modification, physical and mechanical effects. Defects generation and annealing, void swelling, irradiation growth and creep, and irradiation induced effects in reactor materialsare discussed. Current theories and experimental techniques are discussed.

Typically offered in Spring only

NE 761 Radiation Detection (3 credit hours)
Advanced aspects of radiation detection such as computer methods applied to gamma-ray spectroscopy, absolute detector efficiencies by experimental and Monte Carlo techniques, the use and theory of solid state detectors, time-of-flight detection experiments and MÂ¿ssbauer and other resonance phenomena.

Prerequisite: NE 726
Typically offered in Spring only

NE 762 Radioisotope Applications (3 credit hours)
Presentation of advanced principles and techniques of radioisotope applications. Topics include radiotracer principles; radiotracer applications to engineering processes; radioisotope gauging principles; charged particle, gamma ray and neutron radioisotope gauges.

Prerequisite: NE 726
Typically offered in Fall only

NE 765 Verification and Validation in Scientific Computing (3 credit hours)
Advances in scientific computing have made modeling and simulation an important part of engineering and science. This course provides students with understanding and knowledge of comprehensive and systematic development of concepts, principles and procedures for verification, and validation of models and simulations. The methods discussed in class will be applied to wide range of technical fields of engineering (including nuclear and mechanical engineering) and technology. The theory lectures and assignments will be complemented with demonstration computer exercises, examples, and a computer project on uncertainty propagation in modeling.

Restriction: Graduate Standing in College of Engineering or College of Science
Typically offered in Fall only

NE 770 Nuclear Radiation Attenuation (3 credit hours)
Advanced course in computational methods for neutron and photon transport. Methods include Monte Carlo and deterministic solutions to the transport equation for both fixed source and eigenvalue problems. Digital computers employed in the solution of practical problems.

Prerequisite: NE 723 or equivalent
Typically offered in Fall only

NE 772/CE 772 Environmental Exposure and Risk Analysis (3 credit hours)
Course covers the identification, transport, and fate of hazardous substances in the environment; quantification of human exposures to such substances; dose-response analysis; and uncertainty and variability analysis. The general risk assessment framework, study design aspects for exposure assessment, and quantitative methods for estimating the consequences and probablity of adverse health outcomes are emphasized.

Prerequisite: ST 511 or 515
Typically offered in Spring only

NE 777 Radiological Assessment (3 credit hours)
Principles of analyzing environmental radiation transport and resulting human exposure and dose and dose management. Source terms of radiation exposure, the radon problem, transport or radionuclides in the atmosphere, effluent pathways modeling, radiation dosimetry, probabilistic models for environmental assessment, uncertainty analysis, and radiation risk management. A laboratory research project report will be developed as an outcome of this course.

Prerequisite: NE520 & NE504 or NE590 and a semester long statistics course or permission by instructor
Typically offered in Spring only

NE 780 Magnetohydrodynamics & Transport in Plasmas (3 credit hours)
Advanced fluid description of plasmas for magnetic fusion, space and industrial plasmas, and other applications. Emphasis on a first principles approach to transport, equilibria, and stability.

Prerequisite: NE 528, NE/PY 414 and 415
Typically offered in Fall only

NE 781 Kinetic Theory, Waves, & Non-Linear Effects in Plasmas (3 credit hours)
Kinetic theory, waves, and non-linear phenomena in magnetized plasmas. First principles approach to the treatment of instabilities and other collective effects.

Prerequisite: NE 528, NE/PY 414 and 415, Corequisite: MA 775
Typically offered in Fall only

NE 795 Advanced Topics In Nuclear Engineering I (1-3 credit hours)
A study of recent developments in nuclear engineering theory and practice.

Typically offered in Fall and Spring

NE 796 Advanced Topics In Nuclear Engineering II (3 credit hours)
A study of recent developments in nuclear engineering theory and practice.

Typically offered in Fall and Spring

NE 801 Seminar (1 credit hours)
Discussion of selected topics in nuclear engineering.

Typically offered in Fall and Spring

NE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NE 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

NE 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

NE 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

NE 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Nutrition (NTR)

NTR 210 Introduction to Community Food Security (3 credit hours)
This introductory interdisciplinary course teaches students about the many facets of food security in the United States, including historical impacts of race and social class on food security; food justice and food accessibility; the roles of non-profit organizations, government agencies, and disciplinary experts in developing food security efforts; and approaches to developing programs and policies, federal to local, to address the problem. In addition, service-learning experiences in students own communities allow them to gain knowledge about the specific agencies approaches to community food security, critically reflecting upon the experience and creating their own community food security action plan.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

NTR 220 Food and Culture (3 credit hours)
This course explores traditional food cultures around the world; highlighting foodways, flavor profiles, and commonly used ingredients. This course focuses on how and to what extent traditional foodways of US immigrants are impacted by the majority culture and how regional cuisines have been impacted by historical migration patterns. Students will examine their own food culture, biases, and how these impact personal interactions with others through a semester-long project. Food tastings and sensory experiences will expose students to a variety of global and US regional cuisines allowing students to compare and contrast flavor profiles and commonly used ingredients. Course is available to all majors.

GEP Global Knowledge
Typically offered in Summer only

NTR 301/FS 301 Introduction to Human Nutrition (3 credit hours)
Functions, dietary sources, digestion and absorption, deficiencies and excesses of essential nutrients in humans; dietary guidelines; food labels; the study of diet-disease relationships; the role of diet in heart disease, diabetes, hypertension, osteoporosis; energy balance and weight control; dietary supplement regulation; diet and athletic performance.

Prerequisite: Sophomore standing
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

NTR 302 Introduction to Nutrition Research, Communication, and Careers (3 credit hours)
This course exposes students to scientific literature, communication, and careers in the field of nutrition. Students will learn how to critically evaluate scientific literature and communicate that information both orally and in writing. Course topics include: research design, nutritional epidemiology, statistics, scientific writing, professionalism, and current nutrition-related "hot topics." Class time will be a combination of lecture and small or large group discussions and individual or group in-class assignments. Student evaluations include in-class assignments, writing assignments, oral presentations, and exams.

Prerequisite: NTR 301
Typically offered in Fall and Summer

NTR 330 Public Health Nutrition (3 credit hours)
Students will explore factors that affect the health and nutrition of the population as well as how those factors are identified, studied, and applied to improve health issues. Students will identify services and programs available to address nutrition and health issues. Students will analyze current events related to public health, evaluate nutrition related policy, and advocate for issues related to nutrition.

Typically offered in Fall and Summer

NTR 401/FS 401/NTR 501/FS 501 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall and Summer

NTR 410/NTR 510 Maternal and Infant Nutrition (3 credit hours)
Students will explore the current research, controversies, and biological mechanisms related to nutrition for women before, during, and after pregnancy, as well as for infants in utero and after birth.

Prerequisite: NTR 301
Typically offered in Spring and Summer

NTR 411/NTR 511 Public Health Perspectives in Infant Feeding (3 credit hours)
This course is designed to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). In this course, students will learn the basics and importance of infant and young child feeding from a public health perspective. Some of the topics that are covered in this course include the public health considerations of breastfeeding and formula feeding in the US and globally, breastfeeding initiation and infant behavior, lifestyle practices and infant feeding, family challenges related to infant feeding, infant feeding research and global impacts, cultural humility for health care providers, and collaboration among healthcare professionals.

Typically offered in Fall and Summer

NTR 412/NTR 512 Clinical Concepts in Infant Feeding (3 credit hours)
This course is designed to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). Students will learn skills and content required for entry level clinical support for infant feeding. Students will learn the fundamentals of infant positioning, latch, and suckle, assessment skills required to evaluate physical development of both the mother and the infant, milk synthesis, milk production, and milk transfer. This course will also prepare the learner to manage the feeding needs of infants across the age spectrum, from the premature infant to the toddler and older child. We will discuss complicated scenarios, to include breastfeeding with physical anomalies, infant hyperbilirubinemia, hypoglycemia, slow weight gain, failure to thrive, and many others. Students will be required to provide their own transportation for field trips.

P: NTR 411 or NTR 511 and BIO 240
Typically offered in Spring and Summer

NTR 413/NTR 513 Clinical Concepts in Infant Feeding Laboratory (1 credit hours)
The laboratory course is designed to complement course content to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). Students will learn and practice skills required for entry-level clinical support for infant feeding. Students will learn the fundamentals of infant positioning, latch, and suckle, and assessment skills required to evaluate physical development of both the mother and the infant, milk synthesis, milk production, and milk transfer. This course will also prepare the learner to manage the feeding needs of infants across the age spectrum, from the premature infant to the toddler and older child. Students will be expected to provide their own transportation for off-campus experiences.

P: BIO 240 and NTR 411 or NTR 511; C: NTR 412 or NTR 512
Typically offered in Spring only

NTR 415/PO 415/PO 515/NTR 515/ANS 515/ANS 415 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

NTR 419 Human Nutrition and Chronic Disease (3 credit hours)
Current concepts regarding, and physiological bases of the roles of nutrition in the prevention and treatment of acute and chronic disease states in humans with emphasis on the process of scientific discovery, reading of original research and transformation of research findings to public policy.

Prerequisite: Junior standing, ANS 230, or ANS/FS/NTR 301 or ANS/NTR/PO 415
Typically offered in Spring only

NTR 421/NTR 521 Life Cycle Nutrition (3 credit hours)
This course focuses on the physiologic changes and nutritional needs throughout the life cycle. Additionally, students will explore psychosocial and environmental influencers on food consumption and diet quality at each stage of life. Pregnancy and lactation, fetal development, infancy, early childhood, childhood, adolescence, young and middle adulthood, and geriatrics will be examined. Student will apply course content to real-world settings through individual and/or group service-learning projects. Credit will not be given for both NTR 421 and NTR 521.

Prerequisite: NTR 301 and junior standing required
Typically offered in Spring only

NTR 425/ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525/PO 525 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

NTR 440/NTR 540 Child & Adolescent Nutrition (3 credit hours)
In this course, students will gain an in-depth understanding of human nutritional needs during early and middle childhood and adolescence. Students will consider how child development affects nutrition and eating behaviors, explore common nutrition concerns that emerge throughout childhood, and evaluate interventions and policies to improve child and adolescent nutrition. The course also includes an introduction to special topics such as food allergies, disordered eating, child obesity, and vegetarian diets. Assessments are designed to evaluate students' mastery of content knowledge, critical thinking, and communication skills. The course content will be delivered in a variety of ways, including lectures, readings, videos, in-class activities, and guest lectures.

P: NTR 301
Typically offered in Fall and Spring

NTR 454/ANS 554/ANS 454 Lactation, Milk and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

NTR 490 Senior Capstone Experience in Nutrition (4 credit hours)
In this capstone course, students will work in groups to complete research and service projects for community partners while gaining professional experiences in nutrition. Students will be expected to apply their knowledge and skills gained throughout their nutrition coursework to develop solutions to problems in public health and community nutrition. Students will complete comprehensive written and poster presentations about their work as a group, in addition to individual reflection(s) about their learnings. Students must provide their own transportation when visiting their community partner site. Students should complete this course in the last semester (or year) of their degree. NTS and NTA Majors only; Senior status required.

Prerequisite: NTR 301, NTR 302, and NTR 401; Nutrition Science majors only; Senior status required
Typically offered in Fall and Spring

NTR 492 Professional Internship Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 492 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

NTR 493 Research Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain real-world experience in a scientific research program. A minimum of 42 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 493 contract and have it approved by his/her research supervisor, academic advisor and the NTR 493 coordinator. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

NTR 494 Teaching Experience in Nutrition Science (1-3 credit hours)
This course provides an opportunity for students to gain teaching experience relevant to their academic and career goals. A minimum of 45 hours must be completed for each credit hour earned, with 3 credit hours maximum for each experience. The experience must be arranged by the student and approved by the Undergraduate Teaching Coordinator for Nutrition prior to the start of the experience. To gain approval, a student must submit the completed NTR 494 contract and have it approved by his/her experience supervisor, academic advisor and the undergraduate teaching coordinator/course instructor. In addition to the work described in the contract, a student will complete a series of reflective assignments during and at the end of the experience.

Typically offered in Fall, Spring, and Summer

NTR 495 Special Topics in Nutrition (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

NTR 500 Principles of Human Nutrition (3 credit hours)
Overview of fields of Nutritional Sciences; functions of nutrients in the human body; sources and properties of nutrients; relationships of food industry practices to nutrition. Credit will not be given for both NTR (FS)400 and NTR 500

Prerequisite: CH 220 and (CH 221 or CH 223) and (ZO 160 or BIO 181/183)
Typically offered in Summer only

NTR 501/FS 501/NTR 401/FS 401 Advanced Nutrition and Metabolism (3 credit hours)
Nutritional biochemistry and physiology as it relates to establishment of nutrient requirements and Dietary Reference Intakes. Digestion, absorption, metabolism, storage, and excretion of nutrients and other markers of nutritional adequacy or excess with emphasis on micronutrients. Functions of nutrients, in bone muscle, blood, growth and development and communication. Credit will not be awarded for both NTR (FS) 401 and NTR (FS) 501.

Prerequisite: (NTR 301 or NTR 415) and (CH 221 or CH 220 or CH 225)
Typically offered in Fall and Summer

NTR 510/NTR 410 Maternal and Infant Nutrition (3 credit hours)
Students will explore the current research, controversies, and biological mechanisms related to nutrition for women before, during, and after pregnancy, as well as for infants in utero and after birth.

Prerequisite: NTR 301
Typically offered in Spring and Summer

NTR 511/NTR 411 Public Health Perspectives in Infant Feeding (3 credit hours)
This course is designed to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). In this course, students will learn the basics and importance of infant and young child feeding from a public health perspective. Some of the topics that are covered in this course include the public health considerations of breastfeeding and formula feeding in the US and globally, breastfeeding initiation and infant behavior, lifestyle practices and infant feeding, family challenges related to infant feeding, infant feeding research and global impacts, cultural humility for health care providers, and collaboration among healthcare professionals.

Typically offered in Fall and Summer

NTR 512/NTR 412 Clinical Concepts in Infant Feeding (3 credit hours)
This course is designed to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). Students will learn skills and content required for entry level clinical support for infant feeding. Students will learn the fundamentals of infant positioning, latch, and suckle, assessment skills required to evaluate physical development of both the mother and the infant, milk synthesis, milk production, and milk transfer. This course will also prepare the learner to manage the feeding needs of infants across the age spectrum, from the premature infant to the toddler and older child. We will discuss complicated scenarios, to include breastfeeding with physical anomalies, infant hyperbilirubinemia, hypoglycemia, slow weight gain, failure to thrive, and many others. Students will be required to provide their own transportation for field trips.

P: NTR 411 or NTR 511 and BIO 240
Typically offered in Spring and Summer

NTR 513/NTR 413 Clinical Concepts in Infant Feeding Laboratory (1 credit hours)
The laboratory course is designed to complement course content to help prepare learners to become International Board Certified Lactation Consultants (IBCLC). Students will learn and practice skills required for entry-level clinical support for infant feeding. Students will learn the fundamentals of infant positioning, latch, and suckle, and assessment skills required to evaluate physical development of both the mother and the infant, milk synthesis, milk production, and milk transfer. This course will also prepare the learner to manage the feeding needs of infants across the age spectrum, from the premature infant to the toddler and older child. Students will be expected to provide their own transportation for off-campus experiences.

P: BIO 240 and NTR 411 or NTR 511; C: NTR 412 or NTR 512
Typically offered in Spring only

NTR 515/ANS 515/ANS 415/NTR 415/PO 415/PO 515 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

NTR 521/NTR 421 Life Cycle Nutrition (3 credit hours)
This course focuses on the physiologic changes and nutritional needs throughout the life cycle. Additionally, students will explore psychosocial and environmental influencers on food consumption and diet quality at each stage of life. Pregnancy and lactation, fetal development, infancy, early childhood, childhood, adolescence, young and middle adulthood, and geriatrics will be examined. Student will apply course content to real-world settings through individual and/or group service-learning projects. Credit will not be given for both NTR 421 and NTR 521.

Prerequisite: NTR 301 and junior standing required
Typically offered in Spring only

NTR 525/FM 525/ANS 525/PO 525/NTR 425/ANS 425/FM 425/PO 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

NTR 540/NTR 440 Child & Adolescent Nutrition (3 credit hours)
In this course, students will gain an in-depth understanding of human nutritional needs during early and middle childhood and adolescence. Students will consider how child development affects nutrition and eating behaviors, explore common nutrition concerns that emerge throughout childhood, and evaluate interventions and policies to improve child and adolescent nutrition. The course also includes an introduction to special topics such as food allergies, disordered eating, child obesity, and vegetarian diets. Assessments are designed to evaluate students' mastery of content knowledge, critical thinking, and communication skills. The course content will be delivered in a variety of ways, including lectures, readings, videos, in-class activities, and guest lectures.

P: NTR 301
Typically offered in Fall and Spring

NTR 550/ANS 550 Applied Ruminant Nutrition (3 credit hours)
Applied concepts in ruminant nutrition for the practicing agricultural professional. Protein, energy, vitamin and mineral nutrition in relation to the nutritional needs and practical feeding of beef cattle, dairy cattle, sheep, and goats. New developments in feeding systems, feed additives and the prevention and treatment of metabolic disorders. Emphasis on solving problems in case studies. Permission given to undergraduates

Prerequisite: ANS 230 or ANS(NTR,PO) 415. Permission given to undergraduates
Typically offered in Fall only

NTR 554/FS 554 Lactation, Milk, and Nutrition (3 credit hours)
Nutritional properties of milk as a high-quality food with nutritional diversity. Principles of physiology, biochemistry and cell biology in the mammary gland. Procedures of milk production and milk collection for milk quality and nutrition. Human lactation vs. that of domestic animals. Impacts of biotechnology and food safety on dairy production. Credit will not be given for both ANS 454 and 554.

Prerequisite: ANS 230 or FS/NTR 400; BCH 451 or ZO 421
Typically offered in Spring only

NTR 555/FS 555 Exercise Nutrition (3 credit hours)
Metabolism of macro- and micronutrients as affected by exercise and physical activity. Effects of dietary patterns, specific foods, dietary supplements and ergogenic aids on sports performance. Reading and discussion of current literature and individual or group projects.

Prerequisite: NTR 400/500
Typically offered in Spring only

NTR 557/FS 557 Nutraceuticals and Functional Foods (3 credit hours)
This course evaluates the weight of evidence from peer-reviewed scientific literature relating food bioactives, whole foods, and diets to disease prevention, athletic performance, and cognitive development/enhancement. Data are viewed in the context of processing effects, global food and supplement regulations, as well as commercial marketing claims. Key concepts include dose-response, signal transduction, and the use of advanced technologies such as genomics, proteomics and metabolomics. Students will work in teams to develop and write a critical review manuscript suitable for publication.

Typically offered in Fall only

NTR 561/ANS 561 Equine Nutrition (3 credit hours)
This course explores concepts in equine nutrition including digestive physiology of horses, nutrient requirements for different classes of horses and feed management. Ration evaluation and balancing, as well as problem solving will be a core component to this course.

Prerequisite:NTR 500 or NTR/FS 501 or NTR/PO 515
Typically offered in Spring only

NTR 565/ANS 565 Advanced Canine and Feline Nutrition (3 credit hours)
This course is about the advanced principles of nutrition within canines and felines. The course focuses on the unique gastro- intestinal tracts for the two species as well as their specific nutrient requirements and how the animal industry addresses these needs.

Restriction: Graduate Student or Senior with 3.35 GPA; Prerequisite: 400-level Nutrition Course
Typically offered in Fall only

NTR 594 Special Topics in Nutrition (1-6 credit hours)
The study of special problems and selected topics of current interest in nutrition and related fields.

Typically offered in Fall, Spring, and Summer

NTR 601 Master's Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

NTR 624 Topical Problems In Nutrition (1-6 credit hours)
Analysis of current problems in nutrition. Also entails the scientific appraisal and solution of a selected problem designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

NTR 625 Advanced Special Problems In Nutrition (1-6 credit hours)
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing
Typically offered in Spring only

NTR 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

NTR 690 Advanced Special Problems In Nutrition (1-6 credit hours)
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing
Typically offered in Fall only

NTR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NTR 695 Master's Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

NTR 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

NTR 699 Research In Nutrition (1-9 credit hours)
Original research preparatory to the thesis for Master of Science or Doctor of Philosophy degree.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

NTR 701/ANS 701 Protein and Amino Acid Metabolism (3 credit hours)
Study of protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals.

Prerequisite: BCH 453, ZO 421, a 400-level nutrition course
Typically offered in Spring only

NTR 706/FM 706 Vitamin Metabolism (3 credit hours)
Structures, chemical and physical properties, functions, distribution, absorption, transport, metabolism, storage, excretion, deficiencies, and toxicity of vitamins in humans and domestic animals. Interactions between vitamins and other factors affecting vitamin metabolism or bioavailability as well as the nutritional significance of essential fatty acids and metabolism of prostaglandins, prostacyclins and leukotrienes. Application of knowledge will include critical review of scientific literature, experimental design, and formulation of vitamin supplements.

Prerequisite: ANS(NTR,PO) 415 and BCH 453
Typically offered in Fall only

NTR 708 Energy Metabolism (3 credit hours)
Relationship of biochemical and physiological events within the cell, tissue, organ and system with the nutrient needs as sources of energy for productive animal life. Digestion, absorption and metabolism of energy sources. Presentation of processesof energy transformations within living structures in relation to energetics, biological oxidations, coupled reactions, anabolic and catabolic systems, metabolic control, partitioning and efficiency.

Prerequisite: BCH 453 and an introductory NTR course
Typically offered in Fall only

NTR 764/PHY 764/CBS 764 Advances in Gastrointestinal Pathophysiology (3 credit hours)
This course will focus on advanced gastrointestinal physiology and the pathophysiology of deseases of relevance to scientsts involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature rgarding a specific gastrointestinal disease.

Prerequisite: PHY 503, PHY 504
Typically offered in Fall only

NTR 775/PO 775 Mineral Metabolism (3 credit hours)
Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated withmineral functions and the metabolic bases for the development of signs of deficiency.

Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421
Typically offered in Fall only

NTR 790/FM 790 Advanced Feed Formulation (3 credit hours)
Principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

NTR 794 Special Topics in Nutrition (1-6 credit hours)
The study of special problems and selected topics of current interest in nutrition and related fields.

Typically offered in Fall, Spring, and Summer

NTR 801 Doctoral Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

NTR 824 Topical Problems In Nutrition (1-6 credit hours)
Analysis of current problems in nutrition. Also entails the scientific appraisal and solution of a selected problem designed to provide training and experience in research.

Prerequisite: Graduate standing or Senior standing
Typically offered in Fall, Spring, and Summer

NTR 825 Advanced Special Problems In Nutrition (1-6 credit hours)
Directed research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy.

Prerequisite: Graduate standing
Typically offered in Fall only

NTR 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

NTR 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NTR 893 Doctoral Dissertation Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NTR 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

NTR 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

NTR 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Occupational Education (EOE)

EOE 298 Special Topics in Occupational Education (1-3 credit hours)
Individual or group study of particular areas of education at the freshman and sophomore levels.

Typically offered in Fall, Spring, and Summer

EOE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

EOE 699/EAC 699/ECD 699/ECI 699/ELP 699/EMS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring

EOE 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

EOE 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

Operations Research (OR)

OR 425/OR 525/ISE 525/ISE 425 Medical Decision Making (3 credit hours)
This will focus on the use of optimization in Medicine. The main goal of this course is for you to develop an understanding of the recent methodological literature on optimization methods applied to medical decision making. We will cover a broad range of topics, both from the methodological perspective (study models using integer programming, dynamic programming, simulation, etc.) and from the public policy/public health perspective (who are the stake holders, what are the relevant questions modelers can answer, how is the patient taken into account, etc.).

P: ISE/OR 505 or equivalent and ISE 560 or equivalent or permission by instructor
Typically offered in Spring only

OR 433/OR 533/ISE 433/ISE 533 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.

Prerequisite: ISE 361
Typically offered in Spring only

OR 501/ISE 501 Introduction to Operations Research (3 credit hours)
Operations Research (OR) is a discipline that involves the development and application of advanced analytical methods to aid complex decisions. This course will provide students with the skills to be able to apply a variety of analytical methods to a diverse set of applications. Methods considered include linear and mixed-integer programming, nonlinear and combinatorial optimization, network models, and machine learning. Focus will be on how to translate real-world problems into appropriate models and then how to apply computational procedures and data so that the models can be used as aids in making decisions. Applications will include improving the operation of a variety of different production and service systems, including healthcare delivery and transportation systems, and also how OR can be used to make better decisions in areas like sports, marketing, and project management. Prerequisites include undergraduate courses in single variable differential and integral calculus and an introductory course in probability.

Prerequisites include undergraduate courses in single variable differential and integral calculus (similar to MA 421) and an introductory course in probability (similar to ST 421 or ST 371 and ST 372)
Typically offered in Fall and Spring

OR 504/MA 504 Introduction to Mathematical Programming (3 credit hours)
Basic concepts of linear, nonlinear and dynamic programming theory. Not for majors in OR at Ph.D. level.

Prerequisite: MA 242, MA 405
Typically offered in Fall only

OR 505/ISE 505/MA 505 Linear Programming (3 credit hours)
Introduction including: applications to economics and engineering; the simplex and interior-point methods; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.

Prerequisite: MA 405
Typically offered in Fall only

OR 506 Algorithmic Methods in Nonlinear Programming (3 credit hours)
Introduction to methods for obtaining approximate solutions to unconstrained and constrained minimization problems of moderate size. Emphasis on geometrical interpretation and actual coordinate descent, steepest descent, Newton and quasi-Newton methods, conjugate gradient search, gradient projection and penalty function methods for constrained problems. Specialized problems and algorithms treated as time permits.

Prerequisite: Linear algebra or similar coursework (similar to MA 303, MA 405), and knowledge of a computer language, such as Python, MATLAB, Julia, for example.
Typically offered in Fall only

OR 525/ISE 525/ISE 425/OR 425 Medical Decision Making (3 credit hours)
This will focus on the use of optimization in Medicine. The main goal of this course is for you to develop an understanding of the recent methodological literature on optimization methods applied to medical decision making. We will cover a broad range of topics, both from the methodological perspective (study models using integer programming, dynamic programming, simulation, etc.) and from the public policy/public health perspective (who are the stake holders, what are the relevant questions modelers can answer, how is the patient taken into account, etc.).

P: ISE/OR 505 or equivalent and ISE 560 or equivalent or permission by instructor
Typically offered in Spring only

OR 531/MA 531/E 531 Dynamic Systems and Multivariable Control I (3 credit hours)
Introduction to modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems.

Prerequisite: MA 341, MA 405
Typically offered in Fall only

OR 533/ISE 433/ISE 533/OR 433 Service Systems Engineering (3 credit hours)
This course intends to provide a comprehensive treatment on the use of quantitative modeling for decision making and best practices in the service industries. The goal of this class is to teach students to able to identify, understand, and analyze services; and acquire the quantitative skills necessary to model key decisions and performance metrics associated with services. Students will be exposed both to classical and contemporary examples of challenges and opportunities that arise when working in the service sector.

Prerequisite: ISE 361
Typically offered in Spring only

OR 537/CE 537 Computer Methods and Applications (3 credit hours)
Computational approaches to support civil planning, analysis, evaluation and design. Applications to various areas of civil engineering, including construction, structures, transportation and water resources.

Prerequisite: CSC 112 and (MA 341 or MA 305)
Typically offered in Fall only

OR 560/ISE 560 Stochastic Models in Industrial Engineering (3 credit hours)
ISE/OR 560 will introduce mathematical modeling, analysis, and solution procedures applicable to uncertain (stochastic) production and service systems. Methodologies covered include probability theory and stochastic processes including discrete and continuous Markov processes. Applications relate to design and analysis of problems, capacity planning, inventory control, waiting lines, and service systems.

Typically offered in Fall only

OR 562/ISE 562/TE 562 Simulation Modeling (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.

Typically offered in Spring only

OR 565/CSC 565/MA 565 Graph Theory (3 credit hours)
Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matchings and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.

Prerequisite: CSC 226 or MA 351.
Typically offered in Spring only

OR 579/CSC 579/ECE 579 Introduction to Computer Performance Modeling (3 credit hours)
Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queuing network models and operational analysis, economic considerations.

Prerequisite: CSC 312 or ECE 206 and MA 421
Typically offered in Fall and Spring

OR 591 Special Topics in Operations Research (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.

Typically offered in Fall, Spring, and Summer

OR 601 Seminar in Operations Research (1 credit hours)
Seminar discussion of operations research problems. Case analyses and reports. Graduate students with minors or majors in operations research expected to attend throughout period of their residence.

Prerequisite: OR Major or OR Minor
Typically offered in Fall and Spring

OR 610 Special Topics in Operations Research (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.

Typically offered in Fall, Spring, and Summer

OR 652 Practicum in Operations Research (1-3 credit hours)
Practicum in problem solving in industry applying applicable OR methodologies. Practical experience in diagnosing and solving problems in operational systems at either an industrial site or at NC State.

Prerequisite: OR 501, OR 505, OR 709 and OR 761
Typically offered in Summer only

OR 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

OR 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

OR 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

OR 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

OR 699 Master's Thesis Preparation (1-9 credit hours)
For student who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

OR 705 Large-Scale Linear Programming Systems (3 credit hours)
Specialized algorithms for efficient solution of large-scale LP problems. Parametric programming, bounded variable algorithms, generalized upper bounding, decomposition, matrix factorization and sparse matrix techniques. Emphasis on gaining firsthand practical experience with current computer codes and computational procedures.

Prerequisite: OR 505 and FORTRAN programming experience
Typically offered in Spring only

OR 706/ST 706/MA 706 Nonlinear Programming (3 credit hours)
An advanced mathematical treatment of analytical and algorithmic aspects of finite dimensional nonlinear programming. Including an examination of structure and effectiveness of computational methods for unconstrained and constrained minimization. Special attention directed toward current research and recent developments in the field.

Prerequisite: OR(IE,MA) 505 and MA 425
Typically offered in Spring only

OR 708/ISE 708/MA 708 Integer Programming (3 credit hours)
General integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. Students have some "hands on" computing experience that should enable them to adapt ideas presented in course to integer programming problems they may encounter.

Prerequisite: MA 405, OR (MA,IE) 505, Corequisite: Some familiarity with computers (e.g., CSC 112)
Typically offered in Spring only

OR 709/ISE 709 Dynamic Programming (3 credit hours)
Introduction to theory and computational aspects of dynamic programming and its application to sequential decision problems.

Prerequisite: MA 405, ST 421
Typically offered in Spring only

OR 719/MA 719 Vector Space Methods in System Optimization (3 credit hours)
Introduction to algebraic and function-analytic concepts used in system modeling and optimization: vector space, linear mappings, spectral decomposition, adjoints, orthogonal projection, quality, fixed points and differentials. Emphasis on geometricinsight. Topics include least square optimization of linear systems, minimum norm problems in Banach space, linearization in Hilbert space, iterative solution of system equations and optimization problems. Broad range of applications in operations research and system engineering including control theory, mathematical programming, econometrics, statistical estimation, circuit theory and numerical analysis.

Prerequisite: MA 405, 511
Typically offered in Fall only

OR 731/E 731/MA 731 Dynamic Systems and Multivariable Control II (3 credit hours)
Stability of equilibrium points for nonlinear systems. Liapunov functions. Unconstrained and constrained optimal control problems. Pontryagin's maximum principle and dynamic programming. Computation with gradient methods and Newton methods. Multidisciplinary applications.

Prerequisite: OR(E,MA) 531
Typically offered in Spring only

OR 747/ISE 747 Reliability Engineering (3 credit hours)
Introduction to basic concepts of reliability engineering. Application of probability and statistics to estimate reliability of industrial systems; development of reliability measures; analysis of static and dynamic reliability models; development and analysis of fault trees; analysis of Markovian and non-Markovian models; and optimization of reliability models.

Prerequisite: ST 511
Typically offered in Fall only

OR 760/ISE 760 Applied Stochastic Models in Industrial Engineering (3 credit hours)
Formulation and analysis of stochastic models with particular emphasis on applications in industrial engineering; univariate, multivariate and conditional probability distributions; unconditional and conditional expectations; elements of stochastic processes; moment-generating functions; concepts of stochastic convergence; limit theorems; homogeneous, nonhomogeneous and compound Poisson processes; basic renewal theory; transient and steady-state properties of Markov processes in discrete and continuous time.

Prerequisite: MA 303, ST 371
Typically offered in Fall only

OR 761/ISE 761 Queues and Stochastic Service Systems (3 credit hours)
Introduction of general concepts of stochastic processes. Poisson processes, Markov processes and renewal theory. Usage of these in analysis of queues, from with a completely memoryless queue to one with general parameters. Applications to many engineering problems.

Typically offered in Spring only

OR 762/ISE 762/CSC 762 Computer Simulation Techniques (3 credit hours)
Basic discrete event simulation methodology: random number generators, generating random objects, design of discrete event simulation, validation, analysis of simulation output, variance reduction techniques, Markov chain Monte Carlo, simulation optimization. The course has computer assignments and projects.

Students should have completed a course on stochastic models (similar to ISE 560 or ISE 760) and have a working knowledge of a programming language (e.g., Python, Matlab, R, or others).
Typically offered in Fall and Spring

OR 766/ISE 766/MA 766 Network Flows (3 credit hours)
Study of problems of flows in networks. These problems include the determination of shortest chain, maximal flow and minimal cost flow in networks. Relationship between network flows and linear programming developed as well as problems with nonlinear cost functions, multi-commodity flows and problem of network synthesis.

Prerequisite: OR(IE,MA) 505
Typically offered in Spring only

OR 772/ISE 772 Stochastic Simulation Design and Analysis (3 credit hours)
This course is methodologically focused and a continuation of ISE 762 in Monte Carlo methods. The topics include, but are not limited to, Quasi-Monte Carlo, importance sampling and other advanced variance reduction approaches, derivative estimation, and advanced simulation optimization in continuous and finite spaces. While the application of these techniques to actual simulations is practiced as assignments, the discussion on simulation software and programming will be minimal. A current topic research presentation/paper required.

Prerequisite: (CSC,ECE,IE,OR) 762 and ST 516
Typically offered in Spring only

OR 773/ST 773/BMA 773/MA 773 Stochastic Modeling (3 credit hours)
Survey of modeling approaches and analysis methods for data from continuous state random processes. Emphasis on differential and difference equations with noisy input. Doob-Meyer decomposition of process into its signal and noise components. Examples from biological and physical sciences, and engineering. Student project.

Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

OR 774/MA 774/BMA 774 Partial Differential Equation Modeling in Biology (3 credit hours)
Modeling with and analysis of partial differential equations as applied to real problems in biology. Review of diffusion and conservation laws. Waves and pattern formation. Chemotaxis and other forms of cell and organism movement. Introduction to solid and fluid mechanics/dynamics. Introductory numerical methods. Scaling. Perturbations, Asymptotics, Cartesian, polar and spherical geometries. Case studies.

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501
Typically offered in Spring only

OR 791 Advanced Special Topics (1-6 credit hours)
Typically offered in Fall and Spring

OR 801 Seminar in Operations Research (1 credit hours)
Seminar discussion of operations research problems. Case analyses and reports. Graduate students with minors or majors in operations research expected to attend throughout period of their residence.

Prerequisite: OR Major or OR Minor
Typically offered in Fall and Spring

OR 810 Special Topics in Operations Research (1-6 credit hours)
Individual or small group studies of special areas of OR which fit into students' programs of study and which may not be covered by other OR courses. Furthermore, course serves as a vehicle for introducing new or specialized topics at introductory graduate level.

Typically offered in Fall, Spring, and Summer

OR 852 Practicum in Operations Research (1-3 credit hours)
Practicum in problem solving in industry applying applicable OR methodologies. Practical experience in diagnosing and solving problems in operational systems at either an industrial site or at NC State.

Prerequisite: OR 501, OR 505, OR 709 and OR 761
Typically offered in Summer only

OR 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

OR 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

OR 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

OR 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

OR 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Paper Science Engineering (PSE)

PSE 201 Pulping and Papermaking Technology (3 credit hours)
Survey of the pulping and papermaking processes. Covers characteristics of wood and different types of fiber, key equipment and process variables for pulping, bleaching and chemical recovery processes, with emphasis on the kraft process. Papermaking variables and equipment, particularly on a Fourdrinier machine, secondary fiber processing, and aspects of printing and coverting discussed.

Typically offered in Spring only

PSE 211 Pulp and Paper Internship (1 credit hours)
Experience in the pulp and paper industry. Problem solving in an industrial setting to gain insight of pulp and paper technology. Written report required. Engineering ethics discussed in light of the work experience.

Prerequisite: PSE 201
Typically offered in Fall only

PSE 212 Paper Properties (4 credit hours)
Measurement and characterization of the structural, mechanical, and optical properties of paper and board. Effect of raw materials and manufacturing processes on structure and properties. Basic concepts of paper physics.

Prerequisite: PSE 201
Typically offered in Fall only

PSE 220 From Papyrus to Plasma Screens: Paper and Society (2 credit hours)
The impact of paper and paper products on society, examined from the broad interdisciplinary perspectives of technology/engineering and sociology/communication. How the written word and printing affected human development and history. How paper products affect people with regard to communication, education, commerce, and comfort/hygiene. The history and development of paper making and the paper industry. Important properties of paper. Basic types of paper products, how they are manufactured, and their impacts The environmental impacts of paper and the paper industry. Current issues involving the paper industry.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PSE 293 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PSE 294 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PSE 295 Special Topics in Paper Science & Engineering (1-3 credit hours)
Special Topics in Paper Science & Engineering at the 200 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

PSE 322 Wet End and Polymer Chemistry (4 credit hours)
Prepares students to solve problems related to chemical usage on paper machines. Subjects include water chemistry, paper machine operations, fibers, fillers, alum, sizing agents, polyelectrolytes, colloidal interactions, strength agents, dyes, strategies to optimize retention, dewatering strategies, strategies to achieve more uniform paper, strategies to improve production rates, recycling acqueous coatings, and wet-end chemical process control.

Prerequisite: PSE 212 and (CH 221 or CH 225) and (CH 222 or CH 226)
Typically offered in Fall only

PSE 332 Wood and Pulping Chemistry (3 credit hours)
Introduction to carbohydrate chemistry focusing on the structure and reactivity of wood polysaccharides, hemicelluloses and cellulose and on the chemical structure of lignins and wood extractives. Special emphasis on the chemical reaction of wood components occurring in pulping and bleaching processes.

Prerequisite: CH 221/225 and CH 222/226 and CH 223/227 and CH 224/228
Typically offered in Spring only

PSE 335/CH 335 Principles of Green Chemistry (4 credit hours)
Introduction to the topic of green chemistry as an emerging field; Identification of hazards and classes; overview of sources; alternative solvents and reagents; sustainability of chemical reactions; alternative chemical reactions and pathways; alternative feedstocks; enzymatic catalysis; ionic liquids; re-engineering of chemical processes; chemical synthesis.

Prerequisite: Grade of C or better in CH 101/102, CH 201/202 (or equivalent general chemistry series), and CH 221/22 (or equivalent)
Typically offered in Fall only

PSE 355 Pulp and Paper Unit Processes I (3 credit hours)
Selected topics in chemical engineering as applied in the pulp and paper industry. Emphasis on computational practice.

Prerequisite: CHE 205
Typically offered in Fall only

PSE 360 Pulp and Paper Unit Processes II (3 credit hours)
Application of chemical engineering principles to the analysis of pulp and paper unit processes. Emphasis on practical problems in fluid dynamics, heat transfer, mass transfer and thermodynamics. Problem solution techniques include hand calculationand computer simulation tools.

Prerequisite: PSE 201, PSE 355 or CHE 311
Typically offered in Spring only

PSE 370 Pulp and Paper Products and Markets (3 credit hours)
Major product sectors for pulp and paper. Market outlook and analysis. Critical fiber, pulp, finished product requirements and properties. Special emphasis on packaging grades and emerging markets. Technology intelligence and techno-economic tools to identify and address challenges related to selected pulp and paper products. Laboratory session used for research and development of selected products.

Prerequisites: PSE 201 with a C- or better and PSE 212 with a C- or better
Typically offered in Spring only

PSE 371 Pulping Process Analysis (3 credit hours)
Preparation and evaluation of different types of wood pulp. A new wood raw material is selected each year with the purpose of studying and critically evaluating the principal pulping and bleaching variables.

Prerequisite: PSE 201
Typically offered in Spring only

PSE 415 Paper Industry Strategic Project Analysis (3 credit hours)
Design problems in process and project engineering are analyzed from strategic, economic, and business perspectives. Typical pulp and paper processes are computer modeled and analyzed with regard to feasibility and profitability. Specific capital projects are assessed for capital requirements, total installed cost, operating costs, payback, and cash flow. Traditional business concepts are presented, including: financial analysis; capital allocation; marketing and pricing theory; manufacturing work systems; management systems; leadership; what "good" looks like. Senior Standing.

Typically offered in Fall only

PSE 416 Process Design and Analysis (3 credit hours)
Design, management and analysis of technical projects. Emphasis on concepts and techniques used in economic analysis of projects. Use of computer simulation for process design and cost analyses. Team projects to analyze cost and operating feasibility of proposed major mill modification. Written and oral presentations required throughout the semester.

Prerequisite: PSE 415 and PSE 417
Typically offered in Spring only

PSE 417 Modeling & Simulation of Pulp & Paper Processes (3 credit hours)
Application of modeling and simulation techniques for the analysis of pulping and papermaking processes. Model development and computer simulation using existing models will allow analysis of process interactions and operating/economic feasibility of process modifications of complex manufacturing systems.

Prerequisite: PSE 360
Typically offered in Fall only

PSE 425 Bioenergy & Biomaterials Engineering (3 credit hours)
This course acquaints students with the basic science, terminology, technology, economic concepts, and engineering concepts associated with the conversion of biomass into energy and materials. Topics include: biomass types and properties; biochemical platforms; thermochemical platforms; unit operations; the biorefinery; biocomposites. Some design content is included. Targeted to engineering students with a suitable background (PSE, CHE, BAE).

Prerequisite: For PSE Majors: (MAE 201 or CHE 316) and PSE 360; For CHE Majors: CHE 312 and CHE 316; For BAE Majors: MAE 201 and BAE 402
Typically offered in Fall only

PSE 465 Process Engineering (3 credit hours)
Advanced use of process engineering tools in process design, improvement and operation. Particular emphasis is placed on pulp and paper industry. Topics include basic statistics, Lean Six Sigma/DMAIC methodology, statistical software, measurement system analysis, process mapping/value stream mapping, statistical process and quality control, control charts, process capability analysis, hypothesis testing, design of experiments, Excel modeling, and big data analysis. An independent project is required, which can lead to Lean Six Sigma Yellow Belt trained status.

Prerequisite: Senior standing in PSE or SMT
Typically offered in Spring only

PSE 472 Paper Process Analysis (3 credit hours)
Product analysis, materials selection, process planning, manufacture of various types of paper using pilot plant equipment, finished product testing and comparison with standard products. Machine unit operations, materials flow balances, energy balances performed on operations. Team assignments with written and oral presentation of results.

Prerequisite: PSE 212, PSE 322, PSE 371
Typically offered in Spring only

PSE 475 Process Control in Pulp and Paper (3 credit hours)
Overview of the various aspects of control including process modeling, design of control loops and stability analysis in pulp and paper. Emphasis on distributed digital control (DDC), including hands-on programming and control loop development on aDDC computer.

Prerequisite: Senior standing in PSE or SMT
Typically offered in Fall only

PSE 476/FB 576/PSE 576/FB 476 Environmental Life Cycle Analysis (3 credit hours)
Overview of the various aspects of conducting and interpreting an environmental life cycle analysis on a product or service. Students will learn how to construct a life cycle analysis goal and scope, inventory, assessment and interpretation. Skills in the critique and communication of a life cycle analysis will be developed. Includes an overview of the following life cycle stages: raw materials, energy, transportation, production, use, and end of life. Emphasis on systems thinking. Targeted for students in any science or engineering program. Credit not allowed for both PSE 476 and WPS 576.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

PSE 493 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PSE 494 Independent Study in Paper Science & Engineering (1-6 credit hours)
Independent Study for Paper Science & Engineering students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PSE 576/FB 476/PSE 476/FB 576 Environmental Life Cycle Analysis (3 credit hours)
Overview of the various aspects of conducting and interpreting an environmental life cycle analysis on a product or service. Students will learn how to construct a life cycle analysis goal and scope, inventory, assessment and interpretation. Skills in the critique and communication of a life cycle analysis will be developed. Includes an overview of the following life cycle stages: raw materials, energy, transportation, production, use, and end of life. Emphasis on systems thinking. Targeted for students in any science or engineering program. Credit not allowed for both PSE 476 and WPS 576.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

Park Scholars (PRK)

PRK 102 Topics in Scholarship, Leadership, and Service II (0 credit hours)
Interdisciplinary seminar with distinguished speakers and community leaders. A one-two day, off-campus trip will develop student leadership skills through examination of leadership challenges facing North Carolina. Volunteer work with an off-campus service agency will build awareness of community needs and how to address those needs. Students may need to use public transportation, which is free to NC State students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 101, restricted to Park Scholars
Typically offered in Spring only

PRK 202 Topics in Scholarship, Leadership and Service IV (0 credit hours)
Interdisciplinary seminar includes speaker seminars and organizing Service Raleigh, a major spring service project. Planning begins for senior year enrichment activities. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 201, restricted to Park Scholars
Typically offered in Spring only

PRK 302 Topics in Scholarship, Leadership, and Service VI (0 credit hours)
Interdisciplinary seminar to develop leadership skills through a Leadership Academy, attendance at various speaker seminars and dinners, and through continued community volunteerism. The Leadership Academy is a half-day workshop in February and builds on the skills from the fall Leadership Academy. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 301, restricted to Park Scholars
Typically offered in Spring only

PRK 402 Topics in Scholarship, Leadership and Service VIII (0 credit hours)
Interdisciplinary seminar will promote understanding of scholarship, leadership, and service. Students hold a dinner with a William Friday Award recipient, establish their class legacy for the campus, and work with younger students on developing their leadership styles. Students continue to volunteer in the community. Students may need to use public transportation, which is free to NC State Students with their id, to perform required public service. Restricted to Park Scholars.

Prerequisite: PRK 401, restricted to Park Scholars
Typically offered in Spring only

Parks, Recreation, and Tourism Management (PRT)

PRT 150 Recreation, Sport, Tourism, and Event Management Orientation (1 credit hours)
Introduction topics related to the Department of Parks, Recreation and Tourism Management; the recreation, sport, tourism, event, and golf industries; all PRTM curricula; advising, academic skills, and teamwork; and research and personnel involved in the department and college. PRT, SPMGT, and PGM Majors Only.

Typically offered in Fall and Spring

PRT 152 Introduction to Parks, Recreation, Tourism, and Event Management (3 credit hours)
The goal of this course is to provide students with foundational knowledge of the role of recreation and leisure in our society. Facilitators, constraints, and motivational factors related to recreation and leisure behavior are discussed along with the role of recreation in community development and health and well-being across the lifespan. Topics addressed include human views and practices of recreation and leisure behavior, contemporary thinking about the relationship between time, work, and leisure, connections between recreation and wellness, and practices and methods used in the delivery of recreation, tourism, and leisure services (e.g., event planning, program planning, promoting tourism).

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PRT 156 Professional Golf Management Orientation (3 credit hours)
Overview of the golf industry and introduction to the concepts and practices of effective golf management including turfgrass management, golf shop operations, food & beverage control, customer services, personnel management, and tournament operations. Theoretical foundations for understanding leisure behavior and the parks, recreation and tourism management profession.

Prerequisite: PGM Majors
Typically offered in Fall and Spring

PRT 200 Health, Wellness and the Pursuit of Happiness (3 credit hours)
Despite having one of the highest standards of living in the world, a growing number of Americans are unhappy. The purpose of this course is to help students understand the behaviors that are personally beneficial and contribute to a healthy and happy life. Students will learn what research says about what makes us happy and healthy, and how to put those strategies into practice. Course modules focus on activities that have been proven to increase happiness along with strategies to build healthy habits.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PRT 203/IDS 203/NR 203 Humans and the Environment (3 credit hours)
Solutions-focused examination of the varied, complex, and evolving frameworks used to make sense of how individuals & societies connect with the biophysical environment. Emphasis on current issues and relevance of interdisciplinary training to careers including environmental planning and policy, sustainable tourism, parks and recreation management, conservation, environmental education, and climate resilience. Topics include: population dynamics, public land and common resources, renewable natural resources, pollution, water resources, energy and non-renewable resources.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PRT 210 Golf Management I (1 credit hours)
Emphasis on concepts, techniques, and practices of teaching golf skills; understanding the Professional Golfers' Association Constitution; rules of golf, golf tournament operations; and golf car fleet management.

Prerequisite: PGM Majors & PRT 156
Typically offered in Spring only

PRT 211 Golf Management II (1 credit hours)
Advanced concepts, techniques, and practices of teaching golf; golfer development programs, golf club design and repair.

Prerequisite: PGM Majors & PRT 210
Typically offered in Fall only

PRT 212 Golf Instructor Development (2 credit hours)
Students will learn to teach using a variety of instructional methods including various technologicalmethods. Students will also learn to teach to students with a variety of learning styles including visual, auditory and kinesthetic. The students will learn the fundamental theories and concepts of the golf swing as well as basic ball flight laws.

Prerequisite: PGM Majors and PRT 156 and PRT 210
Typically offered in Fall only

PRT 214/HESM 214 Foundations in Outdoor Leadership and Adventure Education (3 credit hours)
Foundations in outdoor leadership and adventure education topics include outdoor education history, group development models, experiential education theories, leadership styles and facilitation, risk management for groups, expedition and trip planning, employment opportunities, current trends and issues, environmental stewardship, assessment and evaluation.

Typically offered in Spring only

PRT 220 Foundations of Tourism and Event Management (3 credit hours)
An exploration of the forces driving the global industries of tourism and event management. Emphasis on using the principles of sustainability to address current challenges and future opportunities in tourism and event management.

Prerequisite: PRT 152
Typically offered in Fall and Spring

PRT 230 Foundations of Outdoor Recreation Management (3 credit hours)
This course explores concepts and methods of outdoor recreation planning and management, with emphasis on public lands. Students will examine environmental and social impacts of recreation and develop strategies that promote quality visitor experiences and sustainable resource management.

Typically offered in Fall and Spring

PRT 238 Diversity and Inclusion in Recreation and Sport (3 credit hours)
The goal of this course is to provide students with knowledge, attitude awareness, and resources needed to understand how to effectively deliver programs and services for people from diverse backgrounds. Students will gain an understanding of people's differences in terms of age, race, ethnicity, sexual identity, class, and disabilities and their barriers to participate in leisure and recreation activities. This course encourages students to cultivate cultural competency and appreciation of different perspectives as they pertain to disability, sport, and recreation. It is intended to enhance your understanding and ability to work with diverse populations. Seven to ten volunteer hours may be required. Students are responsible for providing their own transportation to and from volunteer opportunities.

GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

PRT 240 Geospatial Applications for Parks, Recreation, Tourism and Event Management (3 credit hours)
Geospatial applications have a multitude of uses in both the private and public sectors and are integral to innovative solutions in parks and recreation. Students will gain an understanding of how spatial data are collected, organized, analyzed, and displayed and learn the foundations of representing environmental and social phenomena in a geospatial environment. Student will be able to explain how geospatial tools enable spatial thinking and problem solving for parks, recreation, and tourism applications, such as siting recreation facilities, mapping health-related issues, and creating compelling maps and visuals for destination marketing. Students will apply spatial concepts to hands-on applications, gaining familiarity with commonly used software.

Typically offered in Fall and Spring

PRT 250 Facilities Management in Parks, Recreation, Tourism and Event Management (3 credit hours)
Management principles applied to park, recreation, sport areas and facilities. Emphasis on operational efficiency, quality service, fiscal responsibility and maintenance management.

Prerequisite: PRT 152
Typically offered in Fall and Spring

PRT 266 Introduction to Sport Management (3 credit hours)
Introduction to concepts and practices of effective sport programming and management at the professional, collegiate and community levels. Overview of various program delivery systems such as fitness, instructional sport, informal sport, and intramural sport. Examination of management elements of sport programming, including planning, personnel, finance, facilities, risk and liability and marketing.

Typically offered in Fall, Spring, and Summer

PRT 277 Psychological & Cultural Dimensions of Sport (3 credit hours)
The psychological behavior of the individual in physical activity and sport. The development of sport and the sports industry, political and cultural significance of sport, and sport in international relationships. The relationship between sport, gender, class, ethnicity, health, drugs, violence, education, and life long physical activity.

Prerequisite: Sport Management or PRT Majors, PRT 266
Typically offered in Fall, Spring, and Summer

PRT 286 Writing and Speaking in Sports Organizations (3 credit hours)
Concepts related to effective communication within sport organizations. Including interpersonal communication, group communication, public speaking, use of electronic media, and basic knowledge and understanding of media in sport and sport enterprises.

Prerequisite: Sport Management or PRT Majors, PRT 266
Typically offered in Fall, Spring, and Summer

PRT 292 External Learning Experience (1-3 credit hours)
Learning experience in parks, recreation, tourism, and sports within an academic framework with agencies external to the department. Contact and arrangements with prospective supervisors initiated by the student. Approval by prospective supervisor and departmental undergraduate coordinator necessary. Students can receive between 1 and 3 hours credit for the the learning experience (1 credit = 45 hours) PRT and SMT majors only.

Prerequisite: PRT 152 and Sophomore Standing
Typically offered in Fall, Spring, and Summer

PRT 293 Independent Study in Parks, Recreation, & Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, & Tourism Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 294 Independent Study in Parks, Recreation, & Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, & Tourism Management students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 295 Special Topics in Parks, Recreation, and Tourism Management (1-3 credit hours)
Special topics in the Department of Parks, Recreation, and Tourism Management at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

PRT 307 Services, Facilities and Event Marketing (3 credit hours)
Examination of marketing methods as applied to Parks, Recreation, Tourism and Sport Management facilities and programs. Aspects of advanced marketing: market research, marketing strategy and revenue-generation in both public and private settings.

Prerequisite: PRT 358
Typically offered in Fall only

PRT 311 Golf Course Turf Grass Management (3 credit hours)
Introduction to the roles and responsibilities of the golf course superintendent as well as the practices and procedures associated with golf course turfgrass management. Preparation for completion of Level II Turfgrass Management, elements of the Professional Golfers' Association of America's Professional Golf Management apprentice program. Periodically class/lab meetings require transportation to area golf facilities. Students are expected to provide their own transportation accommodations.

Prerequisite: PGM Majors and PRT 210 and PRT 211
Typically offered in Fall only

PRT 312 Golf Management III (1 credit hours)
Advanced concepts, techniques, and practices of golf management: business analysis, planning and operations, and analysis of the golf swing. Preparation for completion of PGA of America's Professional golf Management Level II knowledge tests and skills simulations.

Prerequisite: PGM Majors and PRT 210 and PRT 211
Typically offered in Spring only

PRT 315 Organization and Administration of Adventure Programs (3 credit hours)
Overview of the organizational and administration of adventure programs and services, professional standards, programming, management, staffing, budgeting, public relations, liability and risk management.

Prerequisite: PRT 152
Typically offered in Spring only

PRT 319 Sustainable Tourism (3 credit hours)
This course introduces the concepts and principles associated with sustainable tourism development, emphasizing on their implications for management and planning purposes. Topics to be addressed include: concept, justification and evolution of sustainable development; socio-cultural, economic, and environmental dimensions of sustainable tourism; positive and negative impacts of tourism development; and principles conducive to sustainable tourism planning and community development. Given that each case of tourism development is unique, examples from the U.S. and around the world will be used to examine and discuss issues and practices of sustainable tourism development within different geo-cultural contexts. This course adopts the Problem-Based Learning Format, which promotes and enhances students' analytical skills, problem solving skill and team working skills. It also adopts TH!NK intellectual standards to encourage critical and creative thinking in evaluating the work of others, solving problems related to sustainable tourism, and reflecting on personal thinking (i.e., metacognition). Junior or senior standing.

Typically offered in Spring only

PRT 342 Recreation and Park Interpretive Services (3 credit hours)
Interpretation is a form of communication in which the technical language of natural sciences and related fields is translated in a way connects people's hearts and minds to a resource. Commonly, interpretation occurs at local, county, state and national parks; state and national forests; other protected areas; as well as natural and cultural history centers and sites. However, these skills can be transferred to any setting in which you are seeking to connect people's hearts and minds to a resource. This course is designed to provide you with fundamental knowledge of environmental and cultural interpretation, as well as develop your practical skills in providing interpretive services. Students will enroll in the National Association of Interpretation Certified Interpretive Guide course and have opportunity to apply for certification ($125 fee). Certification is optional. Students completing this course will also earn a minimum of 20 hours toward NC Environmental Education Certification.

Prerequisite: Junior standing.
Typically offered in Spring only

PRT 358 Recreation Program Planning (4 credit hours)
The ultimate goal of the recreation and park profession is to improve the quality of life for the people and communities we serve. We often do this by providing programs for people. It is important for the student to realize the breadth of recreation program possibilities and to be able to analyze and apply the program planning principles to deliver services in a variety of recreation settings. As a full-immersion service-learning course, PRT 358 is designed to provide knowledge and tools to enable the student to achieve the above objectives. For many students, this should be one of the most valuable courses in the entire PRT curriculum.

Prerequisite: PRT 152
Typically offered in Fall and Spring

PRT 359 Organizational Leadership in Parks, Recreation, Tourism and Event Management (3 credit hours)
Systematic principles for managing human resource component of parks, recreation, event, and tourism organizations. Leadership, group dynamics, human resources planning and organizing, employee recruitment, selection and supervision.

Typically offered in Fall, Spring, and Summer

PRT 366 Sport Programming (3 credit hours)
Foundations, administrative support systems, delivery systems and desirable practices of sport programming. Program delivery systems overview with emphasis on problems and solutions associated with sport programs. Topics include sport league administration, youth sport delivery issues, sport tournament operations, community based sport delivery issues, college/university recreation sport delivery.

Prerequisite: Sport Management and PRT Majors, PRT 266
Typically offered in Fall and Spring

PRT 371 Risk Management in Parks, Recreation, Tourism, and Event Management (3 credit hours)
This course will introduce fundamental concepts and standards of practice related to the creation and maintenance of safe environments in tourism, events, community sport, and outdoor recreation. Topics addressed include risk management, emergency action plans, risk audits, contracts and waivers, basic employment law, and fundamental concepts related to the minimization of injury.

R: Junior standing or above
Typically offered in Fall, Spring, and Summer

PRT 375 Professional Development and Internship Orientation (2 credit hours)
The purpose of PRT 375 is to help students adequately prepare for their internship and for their career following graduation. Students will explore internship opportunities and explore the best practices for internship and/or job seeking through resume preparation, practicing interview skills, utilizing social media, and learning job negotiating skills.

Typically offered in Fall and Spring

PRT 376 Sport Administration (3 credit hours)
Concepts related to policy development, organization and management specific to sport organizations. Including theories and practices of policy development and implementation, management theories, organizational behavior, the strategic management process, organizational design, managing change, and operational planning.

P: PRT 266 and Sports Management students only.
Typically offered in Fall, Spring, and Summer

PRT 380 Evidence-based decision making in Recreation, Sport, Tourism, and Event Management (3 credit hours)
This course demonstrates the value of evidence-based decision making within parks, recreation, tourism, event, golf, and sport (hereafter PRTM) services. It provides an introduction to and application of the processes required for evaluating these services including: development of evaluation criteria, data collection, analysis, synthesis of findings, and communication of results. The course emphasizes an understanding, development, and application of various types of systematic evaluation designs. The understanding and communication of different evaluation techniques and results will be integral.

Prerequisite: 300-level Statistics course, PRT 359
Typically offered in Fall, Spring, and Summer

PRT 406 Sports Law (3 credit hours)
Fundamental principles of law, especially tort and contract law, applied to sports situations. Analysis of liability of sports personnel in various roles including participant, coach, promoter, trainer and official. Analysis of common law court decisions in sports contexts well as key state and federal statutory legislation such as civil rights and antitrust.

Prerequisite: Junior standing.
Typically offered in Fall and Summer

PRT 410 Food and Beverage Management (3 credit hours)
Introduction to practices and procedures in food and beverage service. Basics of food service needs, cost controls, legal issues affecting food and beverage service, staffing, and customer satisfaction. Critical elements of food costing, purchasing, inventory control, menu planning, and security. Preparation for completion of Level III Food and Beverage control elements of the Professional Golfers' Association of America's Professional Golf Management apprentice Program

Prerequisite: Junior standing and PRT 152
Typically offered in Spring only

PRT 411 Club Management (3 credit hours)
Introduction to practices and procedures in contemporary club management. Application of general management functions to club environments including human resources, training, financial management marketing; leadership food and beverage service operations facilities and risk management; legal issues; and career planning. Preparation for completion of Club Management elements of the Professional Golfers' Association of America's Professional Golf Management apprentice Program

Prerequisite: Junior standing, PRT 152
Typically offered in Spring only

PRT 412 Golf Course Architecture (3 credit hours)
Basic principles of golf course design. Historical architectural influences on current golf course design trends. Strategic golf course design principles, shot values, construction practices, environmental issues, and maintenance issues. Golf course design and management implications. Restricted to PGM and Landscape Arch. Majors. Junior Standing

Prerequisite: PRT 211
Typically offered in Fall only

PRT 413 Golf Management IV (1 credit hours)
Advanced concepts, techniques, and practices of golf management: swing concepts of teaching, supervising and delegating, merchandising and inventory control. Preparation for completion of PGA of America's Professional Golf Management Level III knowledge tests and skill simulations.

Prerequisite: PGM Majors and PRT 312
Typically offered in Spring only

PRT 414 PGA Apprentice Program Completion (0 credit hours)
Checkpoint mechanism to register the successful completion of the Professional Golfers' Association Apprentice requirement.

Prerequisite: PGM Majors and PRT 312
Typically offered in Fall and Spring

PRT 415 Principles and Practices of Outdoor Leadership (3 credit hours)
Principles and practices of leadership in adventure education and recreation programs: group management, trip planning, staffing, group dynamics, health and safety issues, risk management and other relevant topics.

Typically offered in Spring only

PRT 420 Destination Planning and Management (3 credit hours)
Destination planning, development, and management from a theoretical and applied perspective. Includes an examination the destination experience, destinations as they fit into the tourism system, and contributions made in the development of the tourism industry.

Prerequisite: PRT 152
Typically offered in Spring only

PRT 430 Tourism, Poverty, and Health (3 credit hours)
Students will learn about the potential role of tourism in fueling equitable development and human health in destination communities, and about the factors that lead to negative social and economic tourism impacts. Students will learn about equitable community development, human health and well-being principles; and about how micro-entrepreneurs and host communities react to the challenges and opportunities posted by tourism development. The course is grounded in scholarly knowledge and is also unreservedly engaged in real life; accordingly, students will work on new ways to help under-resourced individuals pursue dignified livelihoods through tourism. Fieldwork outside of class is required, with a fee of $50.00. PRT majors and PRT minors only.

Typically offered in Fall only

PRT 449/ES 449 Human Dimensions of Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program examines human dimensions of natural and environmental conservation in Australia. The course will involve an orientation and lectures from faculty at James Cook University. Students wills explore the natural environments in Australia including Great Barrier Reed, Tropical Rainforest and Outback and be introduced to Australian culture and history through interactions with communities. Educational travel, active participation, lectures, seminars, and reflective exercises facilitate learning to improve understanding of relationships between human societies and the natural environment. Students must pay program fees, airfare, some meals, and incidentals.

Corequisite: PRT 450
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

PRT 450/ES 450 Sustaining Natural Resources in Australia/New Zealand (3 credit hours)
This 3.5 week study abroad program will examine issues related to natural history and environmental conservation in Australia. This course will involve an orientation and lectures from Australian university faculty. Students will explore natural environments in Australia including the Great Barrier Reef, Tropical Rainforest and Outback; learn about sustainable development and protection of the natural environment through educational travel, field trips, active participation, lecture presentations and seminars, written assignments, research projects and reflective exercises. Students must apply through NCSU Study Abroad Office. Students must pay program fees, airfare, some meals and incidentals.

Corequisite: PRT 449
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Summer only

PRT 451 Principles of Recreation Planning and Facility Development (3 credit hours)
Planning activities analyzed as decision-making processes. Identification, interpretation, evaluation and utilization of data and resources necessary for recreation planning. Planning principles applied in the analysis of proposed and existing recreation sites.

Typically offered in Fall only

PRT 452/PRT 552 Field Experience in Nature-Based Recreation & Tourism Management (3 credit hours)
This dual-listed course provides undergraduate and graduate students with hands-on exposure to the multifaceted nature of national park management and awareness of the complex challenges facing national park managers. Examines nature based recreation and tourism management approaches from an applied and interdisciplinary perspective with applications across federal and state recreation resource management agencies. Students will practice problem-solving techniques and interact with a wide variety of staff from the National Park Service, park partner organizations, and adjacent community managers. This course culminates in a week-long field experience that may conflict with other scheduled courses. Field experience held in conjunction with five other universities in the Great Smoky Mountains National Park. A fee will be assessed for the trip that covers transportation, lodging and meals.

R: Junior or Senior Undergraduate Student Standing
Typically offered in Spring only

PRT 454 Finance and Economics of Parks, Recreation, Tourism, and Event Management (3 credit hours)
Recreation and park fiscal administration, sources of finance for operating and capital expenditures, revenue activities, financial planning, budgeting, expenditure policies, auditing and planning for recreation and park services, decision-making tools, legal aspects of administration.

Prerequisite: PRT 359
Typically offered in Fall, Spring, and Summer

PRT 458 Special Events Planning (3 credit hours)
Theoretical and applied approaches to the planning of special events. Components and considerations of event planning, applied to various recreational settings. Participation in a community special event is required. Attendance at professional conference also required.

Prerequisite: PRT 358
Typically offered in Spring only

PRT 466 Sport Finance and Economics (3 credit hours)
Concepts include sources of revenue for financing, principles of budgeting, spreadsheet utilization, and financial management of sport facilities and enterprises. Additional topics include fundraising principles and methods, economic impact principles and their application to sport venues and events, economic theory applied to sport manufacturing, service industries, professional sports, stadiums and arenas, intercollegiate sports, and the sport club industry.

Prerequisite: Sport Management and PRT Majors, PRT 266, ACC 210, and (ARE 201 or EC 201 or EC 205)
Typically offered in Fall, Spring, and Summer

PRT 475 Recreation and Park Internship (8 credit hours)
Provides prospective park, recreation and leisure service professionals a 400-hour (ten week) learning experience in a selected agency or organization, under the joint supervision of a qualified manager and a university internship supervisor. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PRT 350, PRT 358, PRT 359, PRT 375, PRT 380, 100 hours of approved work experience.
Typically offered in Fall, Spring, and Summer

PRT 476 Sport Marketing (3 credit hours)
Fundamental marketing principles and concepts related to the sport industry. Overview of marketing mix, marketing strategies and the bases of segmentation, sponsorship, licensing, fundraising and merchandising. Special emphasis on the marketing of sport and its strong relationship to research. Credit will not be given for both PRT 476 and PRT 407.

Prerequisite: PRT 486, Sport Management or PRT Majors, PRT 266
Typically offered in Fall and Spring

PRT 478 Sustainable Sport Facility Management (3 credit hours)
In this course, students will examine the development and management of sport facilities, paying particular attention to environmental concerns and the sustainability of the sport stadia. Specifically, the course first focuses on the 3 E's of sustainability (Environment, Equity, Economics) and learn about sustainable systems. From this underpinning, the course is divided into two main frameworks: 1. Development of sport facilities; and 2. Sport facility operations. Each part of the course is enhanced by guest lectures from industry experts and hands on learning experiences.

R: Sport Management Majors only
Typically offered in Fall, Spring, and Summer

PRT 485 Environmental Education in Practice (3 credit hours)
This course is designed to prepare students to enter the environmental education (EE) profession. Topics will include EE professional standards, program planning and delivery, and program evaluation. A significant portion of the course focuses on securing and completing a field placement involving at least 10 contact hours with learners through teaching or observations. In addition, students are expected to attend an EE professional conference which may require overnight travel. Completion of course activities will provide 50-80 hours toward the NC Environmental Education Certification Program. Only students who have taken EMS 350 (Environmental Education Teaching Methods) will be enrolled, except with permission from the instructor.

Typically offered in Spring only

PRT 491 Special Topics in Recreation (1-3 credit hours)
Investigation and analysis of a problem associated with recreation resources.

Typically offered in Fall, Spring, and Summer

PRT 493 Independent Study in Parks, Recreation, and Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, and Tourism Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 494 Independent Study in Parks, Recreation, and Tourism Management (1-6 credit hours)
Independent Study for Parks, Recreation, and Tourism Management students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PRT 500 Conceptual Foundations of Recreation (3 credit hours)
Exploration of the conceptual foundations of leisure, recreations, sport, play, and work, the history of ideas in the field and the relationships of these ideas to contemporary professional and social problems. Restricted to PRTM masters and students and others by consent of the instructor. This course will be offered in an accelerated seven-week format.

Restriction: PRT Grad Students Only
Typically offered in Fall only

PRT 501 Research Methods In Recreation (3 credit hours)
Examination and understanding of advanced scientific investigative methods in their application toward explaining recreation and leisure behavioral phenomena and for resolution of recreation management problems.

Restricted to: Graduate-level Statistics
Typically offered in Spring only

PRT 503 Advanced Fiscal Management for Parks, Recreation, Tourism and Sport Organizations (3 credit hours)
This course is intended to provide students with advanced concepts of fiscal management as applied to the unique industries of parks, recreation, tourism and sport management. Emphasis will be placed on understanding how the receipt, disbursement, and utilization of funds can foster sustainability within these types of organizations. Additionally, this course will focus on developing the skills necessary to apply ethical financial analysis principles through financial risk management. This course is restricted to PRTM masters students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 504 Data Management and Applications in Parks, Recreation, Tourism and Sport Management (3 credit hours)
Introduction to procedures and techniques used in research and evaluation in parks, recreation, sport, and tourism settings to solve management problems. The course emphasizes techniques for data collection, management, analysis, and communication of research findings. This course is restricted to PRTM masters students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 505 GIS and Spatial Analysis in PRTS (3 credit hours)
Introduction to spatial reasoning and spatial analysis as implemented in geographic information systems (GIS) to perform evaluation and research in parks, recreation, tourism, and sport settings. This course is restricted to PRTM master's degree students or others with consent of the instructor.

Prerequisite: Graduate Standing and MPRTSM
Typically offered in Spring only

PRT 506 Organizational Behavior and Leadership in Parks, Recreation, Tourism and Sport (3 credit hours)
This course will focus on the organization and administration of public, private and not-for-profit park, recreation, tourism and sports (PRTS) agencies. Emphasis will be placed on understanding the structural, human, political, and cultural factors that impact organizational efficiency and effectiveness - specifically focusing on these environments. The course will primarily address issues related to organization, management, ethical leadership, human personnel supervision, theory, and research. This course is restricted to PRTM master's degree students or by permission of instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Fall only

PRT 507 Strategic Marketing Management in Parks, Recreation, Tourism and Sport Organizations (3 credit hours)
This course examines the theoretical principles and applications of marketing and promotion strategies for recreational sport and key marketing concepts and strategies using case studies. There is significant discussion on marketing activation, leveraging strategies of sport/event sponsor brands/ companies, and developing a marketing plan. This course is restricted to PRTM master's degree students and others with the content of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Spring only

PRT 508 Risk Management for Parks, Recreation, Tourism and Sport Organizations (3 credit hours)
This course explores risk management in PRTs organizations with an emphasis on ethical managerial strategies. The topics include legal concepts related to specific managerial functions, impacts on functions in recreation environments that result in more efficient and successful operation and protection for the organization. In addition, effective strategies for risk management related to facilitating active-healthy lifestyles and sustainable communities will be explored. This course is restricted to PRT master's degree students and others by consent of the instructor. This course will be offered online in an accelerated seven-week format.

Typically offered in Summer only

PRT 509 Program Evaluation for Parks, Recreation, Tourism and Sport Organizations (3 credit hours)
This course focuses on the development of a working knowledge of the rationale, procedures and tools for conducting sound program evaluation assessments in parks, recreation, tourism, and sport organizations. Effective skills for mastering comprehensive program evaluation strategies including formative, summative, and knowledge building strategies are taught. Students explore social science methods specifically appropriate for evaluation of youth programs.

Typically offered in Summer only

PRT 510 Active Recreation and Community Health (3 credit hours)
This course focuses on the association of active recreation in communities and community health. Students explore individual, social, community, environmental, and policy factors that affect community health and the contribution of recreation and park programs and facilities. This is a seven week course.

Typically offered in Spring only

PRT 511 Sport and Entertainment Venue Management - Facilities (3 credit hours)
In this course, students will examine the management of sport facilities, paying particular attention to environmental concerns and the sustainability of the event venue. Specifically, we will first focus on the three E's of sustainability (Environment, Equity, Economics) and learn about sustainable systems. From this underpinning, the class will be divided into six critical topic areas of sport facility managment: 1. History and role of venues 2. Venue Safety and Security 3. Venue Policy and Procedures 4. Food and Beverage Operations 5. Transportation and Parking Management 6. Ancillary Revenue Sources

Typically offered in Fall only

PRT 512 Sport and Entertainment Venue Management - Operations and Services (3 credit hours)
A thorough background on operations and services is essential for sport and entertainment venue managers. This course examines venue management by covering essential managerial functions. These include management and human resources, customer service and crowd management, managing volunteers, scheduling and booking venues, and ticket office operations.

Typically offered in Spring only

PRT 550 Human Behavior and the Environment (3 credit hours)
This course helps students understand the variety of cognitive, social, affective, and environmental factors that influence human behavior in natural resource contexts, with an emphasis on nature-based recreation experiences and conservation behaviors. Students will explore behavioral models from different disciplines, examine pathways to promote behavior change, and assess implications for park management, environmental stewardship, and natural resource conservation.

Typically offered in Fall only

PRT 552/PRT 452 Field Experience in Nature-Based Recreation & Tourism Management (3 credit hours)
This dual-listed course provides undergraduate and graduate students with hands-on exposure to the multifaceted nature of national park management and awareness of the complex challenges facing national park managers. Examines nature based recreation and tourism management approaches from an applied and interdisciplinary perspective with applications across federal and state recreation resource management agencies. Students will practice problem-solving techniques and interact with a wide variety of staff from the National Park Service, park partner organizations, and adjacent community managers. This course culminates in a week-long field experience that may conflict with other scheduled courses. Field experience held in conjunction with five other universities in the Great Smoky Mountains National Park. A fee will be assessed for the trip that covers transportation, lodging and meals.

R: Junior or Senior Undergraduate Student Standing
Typically offered in Spring only

PRT 555 Environmental Impacts of Recreation and Tourism (3 credit hours)
Understanding of environmental impacts of recreation and tourism, and different methods for assessing and managing such impacts. Examination of the scientific and management literature and application of impact assessment techniques.

Typically offered in Fall only

PRT 560 Theory and Practice of Partnerships for Conservation and Community Sustainability (3 credit hours)
Understanding of collaborative processes and the role of partnerships in public land management, community based conservation, tourism development, and community health and recreation. Examination of literature and evaluation of collaboration and partnerships in practice.

Typically offered in Spring only

PRT 575 Children and Nature (3 credit hours)
In recent decades, there has been an explosion of research around the benefits of nature, supporting measures of happiness, health, attention spans, social cohesion, and others. In parallel to these studies on how nature benefits people (especially children), work has emerged on how children may also be good for nature. Children are leading global movements to combat climate change, becoming civically active to ensure access to nature for all, and proving to be an avenue to bring even the most politically divided communities together to work toward a sustainable future. In this course, students will gain an overview of this rapidly growing literature, meet some of the researchers behind it, and find ways to contribute to it. Perspectives of graduate students from natural resources, education, landscape architecture, or others who are interested in exploring how nature can benefit kids and kids can benefit nature are most welcome.

R: Graduate Standing or Permission of Instructor
Typically offered in Fall only

PRT 595 Special Topics In Recreation Resources (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PRT 610 Special Topics In Recreation Resources (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PRT 620 Recreation Resources Problems (1-4 credit hours)
Assigned or selected problems in field of recreation administration, planning, supervision, maintenance, operations, financing or program. Special research problems selected on basis of interest of students and supervised by members of graduate faculty.

Prerequisite: Advanced Undergraduate standing or Graduate standing
Typically offered in Fall, Spring, and Summer

PRT 650 Professional Electronic Portfolio for Parks, Recreation and Tourism Management (1 credit hours)
Students will develop a personalized digital portfolio of the work completed in all required courses in the Masters of Parks, Recreation & Tourism Management program. The portfolio should include evidence, reflection, and critical analysis of core competencies achieved throughout their academic course of study. This course must be taken during a student's last semester after he or she has completed all the required courses.

Prerequisite: Graduate Standing and PRT 500 and PRT 504 and PRT 505 and PRT 506 and PRT 508 and PRT 503 and PRT 507.
Typically offered in Fall and Spring

PRT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

PRT 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PRT 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PRT 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student
Typically offered in Summer only

PRT 700 Advanced Theories of Leisure (3 credit hours)
This course is designed to examine theory as it can be applied to understanding of leisure behavior and parks, recreation, and tourism management research. The goal is to provide a foundation for identifying, evaluating, and applying theoretical perspectives to PRTM research. Students are expected to engage in a critical analysis of theory in PRTM. Ph.D. student

Typically offered in Fall only

PRT 701 Research Methods in Parks, Recreation, & Tourism Management (3 credit hours)
The overall goal of this course is to provide students with a background in advanced social science research methods commonly used in PRTM-related fields as well as strategies for planning, designing, evaluating, and applying research using the social science framework. This course will also be designed in a way to guide students through the phases of the research design and to develop a research proposal.

Completion of PRT 500/700 or concurrently enrolled; Graduate Status
Typically offered in Fall only

PRT 705 Qualitative Research Methods in Conservation & Community Sustainability (3 credit hours)
Examination of qualitative research methods and designs in the contexts of human dimensions of natural resources, equitable and sustainable tourism development, and community health and well-being, including data generation, organization, analysis, quality and presentation. A research project will be conducted with the application of qualitative data organization software.

P: Doctoral student status, or with consent of instructor.
Typically offered in Spring only

PRT 730 Tourism, Community Health, and Sustainability (3 credit hours)
In this course students will examine the potential role of tourism in mitigating or exacerbating health disparities and environmental degradation in rural poor areas. The course endorses an academic ethic of engaged scholarship. Students will be asked to make original contributions to participatory development scholarship, and they will be asked to collaborate with community partners on an applied project addressing tourism, health disparities and environmental degradation in an economically depressed rural community. Consistent with the engaged nature of this course, we will travel to rural communities to meet stakeholders, collect data, and provide coaching/training to tourism micro-entrepreneurs.

Typically offered in Spring only

PRT 795 Special Topics in Recreation Resources (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

PRT 801 Doctoral Seminar in Parks, Recreation and Tourism Research (1 credit hours)
Research studies, scientific articles and progress reports on research effects presented and critically evaluated. Each student pursuing a doctoral degree is expected to take this offering four times for one hour of credit each time.

Typically offered in Fall and Spring

PRT 810 Special Topics In Recreation Resources (1-6 credit hours)
Special topics in various aspects of recreation resources developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PRT 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PRT 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PRT 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Philosophy (PHI)

PHI 205 Introduction to Philosophy (3 credit hours)
Introduction to selected problems of enduring philosophical importance, including such topics as the nature of morality, knowledge, human freedom, and the existence of God. Content varies with different sections.

Credit is not allowed for both PHI 205 and PHI 210.
GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 210 Representation, Reason and Reality (3 credit hours)
This course is an introduction to philosophical issues concerning topics such as language, thought, knowledge, reason, truth, and reality through the study of problems, puzzles, and paradoxes. Not both PHI 205 and PHI 210 may be used towards satisfaction on PHI major or PHI minor requirements.

Credit is not allowed for both PHI 210 and PHI 205
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

PHI 214 Issues in Business Ethics (3 credit hours)
An analysis and evaluation of major issues in business ethics. Topics include the social responsibility of business; social justice and free enterprise; the rights and duties of employers, employees, manufacturers, and consumers; duties to the environment, the world's poor, future generations, and the victims of past injustices; the moral status of the corporation; and the ethics of advertising.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 221 Contemporary Moral Issues (3 credit hours)
Philosophical analysis and theory applied to a broad range of contemporary moral issues, including euthanasia, suicide, capital punishment, abortion, war, famine relief, and environmental concerns.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PHI 227 Data Ethics (3 credit hours)
Application of theories of moral right to issues such as free speech and "information pollution"; privacy and security; and algorithmic fairness, inequality and transparency.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PHI 250 Thinking Logically (3 credit hours)
Deductive arguments attempt to guarantee their conclusions. Inductive arguments attempt to make their conclusions more probable. Using a small number of simple, powerful logical techniques, this course teaches you how to find, analyze and evaluate deductive and inductive arguments, and thus how to avoid the most common errors in reasoning.

GEP Mathematical Sciences
Typically offered in Fall and Spring

PHI 298 Special Topics in Philosophy (3 credit hours)
Selected studies in philosophy that do not appear regularly in the curriculum. Topics will be announced for each semester in which the course is offered.

PHI 300 Ancient Philosophy (3 credit hours)
Western philosophy of the ancient world, with special emphasis on Plato and Aristotle.

GEP Humanities
Typically offered in Fall and Spring

PHI 301 Early Modern Philosophy (3 credit hours)
Western philosophy of the 17th and 18th centuries, including such philosophers as Descartes, Hobbes, Leibniz, Locke, Berkeley, Hume, and Kant.

GEP Humanities
Typically offered in Fall and Spring

PHI 302 19th Century Philosophy (3 credit hours)
Western philosophy of the 19th century, including such philosophers as Kant, Hegel, Schopenhauer, Kierkegaard, Marx, and Nietzsche.

GEP Humanities
Typically offered in Fall only

PHI 305 Philosophy of Religion (3 credit hours)
The existence and nature of God, including such topics as traditional proofs of God, skeptical challenges to religious belief, miracles, the problem of evil, faith and reason, and religious experience.

GEP Humanities
Typically offered in Fall and Spring

PHI 309 Political Philosophy (3 credit hours)
Philosophical study of important political ideas and values such as liberty, equality, justice, rights, and democracy. May include readings from classical and contemporary sources.

Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 310 Existentialism (3 credit hours)
Philosophy of Existentialism, including such thinkers as Kierkegaard, Nietzsche, Doestoevsky, Sartre, Heidegger, and Camus.

GEP Humanities
Typically offered in Spring only

PHI 312 Philosophy of Law (3 credit hours)
Fundamental legal issues such as what constitutes a law or legal system. Justifications of legal interference with individual liberty. Philosophical legal issues illustrated by specific legal cases.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PHI 313 Ethical Problems in the Law (3 credit hours)
Explores uses of the legal system, including such topics as the death penalty, plea bargaining, legalizing euthanasia, censorship, Good Samaritan laws, the insanity defense, civil disobedience, preferential treatment.

Prerequisite: PHI 221 or PHI 375 or PHI 376
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 319 Black Political Philosophy (3 credit hours)
Black thought on central issues in political philosophy such as justice, equality and state authority. Readings will be selected from the works of several Black thinkers, including figures such as W. E. B. Du Bois, Kwame Nkrumah, Charles Mills and Angela Davis.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

PHI 320 Philosophy of Race (3 credit hours)
Fundamental philosophical questions raised by the concept of race, such as whether race is a legitimate category for identifying human beings, and whether the category of race reinforces racism.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

PHI 325/STS 325 Bio-Medical Ethics (3 credit hours)
Interdisciplinary examination and appraisal of emerging ethical and social issues resulting from recent advances in the biological and medical sciences. Abortion, euthanasia, physician-assisted suicide, compromised infants, aids, reproductive technologies, and health care. Focus on factual details and value questions, fact-value questions, fact-value interplay, and questions of impact assessment and policy formulation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PHI 330 Metaphysics (3 credit hours)
Problems of metaphysics, including such topics as: possibility and necessity, paradoxes of time travel, nature of space and time, free will and determinism, causation, mind-body problem and identity-over-time.

Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 331 Philosophy of Language (3 credit hours)
Introduction to traditional and modern accounts of the relations between language and reality, the nature of truth, problems of intentionality and propositional attitudes.

Prerequisite: One PHI course
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 332 Philosophy of Psychology (3 credit hours)
Problems and controversies that overlap the boundary between philosophy and psychology: the mind/body problem, behaviorism vs. cognitivism, the prospects for artificial intelligence, and language and the questions of innate knowledge.

Prerequisite: One PHI course or one PSY course
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 333 Knowledge and Skepticism (3 credit hours)
Analysis of such central concepts as knowledge, belief, and truth, and the investigation of the principles by which claims to knowledge may be justified.

Prerequisite: One PHI course
GEP Humanities
Typically offered in Spring only

PHI 340 Philosophy of Science (3 credit hours)
Nature of science highlighted by differences between science and pseudoscience, relationships between science and religion, and roles of purpose-directed (teleological) and causal explanation in physical, life and social sciences.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PHI 347 Neuroscience and Philosophy (3 credit hours)
Introduction to principal theoretical, empirical and normative issues at the intersection of neuroscience and philosophy, including such issues as: consciousness, the mind's I and the brain's I: free will, moral responsibility and neuroscience; the ethics of personal enhancement; brains, human nature and personal identity; neuroscientifically informed evaluation of well-being.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PHI 375 Ethics (3 credit hours)
Examination of traditional questions of philosophical ethics: What are the principles of moral conduct? What sort of life is worthy of a human being? Includes both classic and contemporary literature.

GEP Humanities
Typically offered in Fall and Spring

PHI 376 History of Ethics (3 credit hours)
Topics in the history of ethics. Philosophers to be studied may include Plato, Aristotle, Aquinas, Butler, Hume, Kant, Sidgwick and Nietzsche.

Prerequisite: One PHI course
GEP Humanities
Typically offered in Fall only

PHI 401 Kant's Critique of Pure Reason (3 credit hours)
A text-based critical study of Kant's Critique of Pure Reason Focusing on such topics as perception, judgment, knowledge, space, time, substance, causation and reality. Students cannot receive credit for both PHI 401 and PHI 501.

Prerequisite: 6 credits in PHI. Credit is not allowed for both PHI 401 and PHI 501.
GEP Humanities

PHI 403 Continental Philosophy After 1900 (3 credit hours)
Key themes in continental European philosophy after 1900. Work studied will include selections from writings of authors in at least two major traditions, e.g., phenomenology, hermeneutics, structuralism, and critical theory. Junior standing or above required. Students may not receive credit for both PHI 403 and PHI 503.

R: Junior standing or above
GEP Humanities
Typically offered in Spring only

PHI 420 Global Justice (3 credit hours)
The applications of the ideas of justice and right beyond and across the borders of individual nation states, attending to the facts of globalization and their consequences for political and economic justice and human rights. Topics: skepticism about global justice; transnational distributive justice, pollution, and poverty; national sovereignty, self-determination, and intervention; the ethics of war; international human rights; and global democracy. No one can receive credit for both PHI 420 and PHI 520.

Prerequisite: One PHI course. Credit is not allowed for both PHI 420 and PHI 520.
GEP Humanities

PHI 425/PSY 425 Introduction to Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.

Prerequisite: One upper-level PHI, PSY, CSC or Linguistics course. Credit is not allowed for PHI 425 and PHI/PSY 525.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PHI 440 The Scientific Method (3 credit hours)
Detailed examination of core issues in the philosophy of science: the confirmation of scientific theories, falsification, projectibility, the nature of scientific explanation, laws of nature, and causation. Students cannot receive credit for both PHI 440 and PHI 540.

Prerequisite: One PHI course. Credit is not allowed for both PHI 440 and PHI 540.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 447 Philosophy, Evolution and Human Nature (3 credit hours)
This course covers philosophical issues in the evolutionary study of human cognition: the role of adaptationism; the values of psychological vs. behavioral approaches; the phenotypic gambit; the evolution of morality and altruism; the nature of culture and the possibility of cultural evolution; innateness, genetic determinism and development; and case studies of evolutionary explanation of human behavior or psychology. Students cannot receive credit for both PHI 447 and PHI 547.

Prerequisite: One 300 level or higher course in Philosophy, Biology, Psychology or Anthropology. Credit is not allowed for PHI 447 and PHI 547.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

PHI 475 Ethical Theory (3 credit hours)
An introduction to some central themes and issues in ethical theory. Topics in normative and meta-ethics such as consequentialism, deontology, virtue ethics, constructivism, realism, relativism, subjectivism, and expressivism. Readings primarily from contemporary literature.

Prerequisite: PHI 375 or PHI 376. Credit is not allowed for both PHI 475 and PHI 575.
Typically offered in Spring only

PHI 494 Research and Writing in Ethics (1 credit hours)
A substantial paper in ethics, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PHI 250 or LOG/MA 201 or LOG/MA 335 and one other (non PHI 250) PHI course. Corequisite: One of (PHI 298, 302, 309, 310, 313, 319, 325, 375, 376, 403, 420, 475, or 498)
Typically offered in Fall, Spring, and Summer

PHI 495 Research and Writing in History of Philosophy (1 credit hours)
A substantial paper in history of philosophy, assigned by the instructor of the co-requisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PHI 250, LOG 201 or 335 and one other (non-PHI 250) PHI course; Co-requisite: One of PHI 298, 300, 301, 302, 310, 401, 403 or 498
Typically offered in Fall, Spring, and Summer

PHI 496 Research and Writing in Contemporary Philosophy (1 credit hours)
A substantial paper in contemporary philosophy, assigned by the instructor of the corequisite; enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: (PHI 250 or LOG 201 or LOG 335) and one other PHI course; Corequisite: One of PHI 298, 305, 310, 320, 330, 331, 332, 333, 340, 347, 403 425, 440, 447 or 498
Typically offered in Fall, Spring, and Summer

PHI 497 Research and Writing in Logic, Representation and Reasoning (1 credit hours)
A substantial paper in logic, representation and reasoning, assigned by the instructor of the corequisite. enrollment subject to departmental approval; may be repeated for credit. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: LOG 201 or 335, and one other PHI course, not PHI 250, Corequisite: One of LOG/MA 335, LOG 430/530, 435/535, PHI 298, 330, 331, 332, 333, 347, 340, 425/525, 440/540 or 447/547
Typically offered in Fall, Spring, and Summer

PHI 498 Special Topics in Philosophy (1-6 credit hours)
Detailed investigation of selected topics in philosophy. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study.

Prerequisite: Six credits in PHI courses
Typically offered in Fall and Spring

PHI 501 Kant's Critique of Pure Reason (3 credit hours)
A text-based critical study of Kant's Critique of Pure Reason focusing on topics such as perception, judgment, knowledge, space, time, substance, causation, and reality. Students cannot receive credit for both PHI 401 and PHI 501.

Prerequisite: Graduate Standing. Credit is not allowed for both PHI 501 and PHI 401.

PHI 503 Continental Philosophy After 1900 (3 credit hours)
Key themes in continental European philosophy after 1900. Work studied will include selections from writings of authors in at least two major traditions, e.g., phenomenology, hermeneutics, structuralism, and critical theory. Students cannot receive credit for both PHI 403 and PHI 503. Junior standing is required for PHI 403. Graduate standing is required for PHI 503.

R: Graduate Standing
Typically offered in Spring only

PHI 520 Global Justice (3 credit hours)
The applications of the ideas of justice and right beyond and across the borders of individual nation states, attending to the facts of globalization and their consequences for political and economic justice and human rights. Topics: skepticism about global justice; transnational distributive justice, pollution, and poverty; national sovereignty, self-determination, and intervention; the ethics of war; international human rights; and global democracy. No one can receive credit for both PHI 420 and PHI 520.

Prerequisite: Graduate standing. Credit is not allowed for both PHI 520 and PHI 420.

PHI 525/PSY 525 Introduction To Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.

Prerequisite: Graduate standing. Credit is not allowed for PHI 525 and PHI/PSY 425.
Typically offered in Spring only

PHI 540 The Scientific Method (3 credit hours)
Detailed examination of core issues in the philosophy of science: the confirmation of scientific theories, falsification, projectibility, the nature of scientific explanation, laws of nature, and causation. Students cannot receive credit for both PHI 440 and PHI 540.

Prerequisite: Graduate standing. Credit is not allowed for both PHI 540 and PHI 440.
Typically offered in Fall only

PHI 547 Philosophy, Evolution and Human Nature (3 credit hours)
This course covers philosophical issues in the evolutionary study of human cognition: the role of adaptationism; the values of psychological vs. behavioral approaches; the phenotypic gambit; the evolution of morality and altruism; the nature of culture and the possibility of cultural evolution; innateness, genetic determinism and development; and case studies of evolutionary explanation of human behavior or psychology. Students cannot receive credit for both PHI 447 and PHI 547.

Credit is not allowed for both PHI 547 and PHI 447. Graduate Standing Required.
Typically offered in Fall only

PHI 575 Ethical Theory (3 credit hours)
An introduction to some central themes and issues in ethical theory. Topics in normative and meta-ethics such as consequentialism, deontology, virtue ethics, constructivism, realism, relativism, subjectivism, and expressivism. Readings primarily from contemporary literature.

Prerequisite: Graduate Standing. Credit is not allowed for both PHI 575 and PHI 475.
Typically offered in Spring only

PHI 598 Special Topics in Philosophy (3-6 credit hours)
Typically offered in Fall and Spring

PHI 696 Summer Thesis Res (1 credit hours)

PHI 816 Introduction to Research Ethics (1 credit hours)
Institutional rules guiding the responsible conduct of research (RCR) and their philosophical justification. Rudiments of moral reasoning and their application to RCR. Topics: plagiarism, falsification and fabrication of data, and ethics versus custom, law, science, and religion.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PHI 896 Summer Dissert Res (1 credit hours)

Physics (PY)

PY 123 Stellar and Galactic Astronomy (3 credit hours)
Introductory, descriptive survey of stars, galaxies and cosmology, designed primarily for non-science majors. Exotic recent discoveries such as quasars, pulsars, and black holes will be included. Complements PY 124, Solar System Astronomy. Companion laboratory course PY 125.

GEP Natural Sciences
Typically offered in Fall and Spring

PY 124 Solar System Astronomy (3 credit hours)
Introductory, descriptive survey of the solar system designed primarily for non-science majors, including current results from space probes, history of astronomy, and the motions of the moon, stars, and planets in the night sky. Complementary course covering stars, galaxies and cosmology (PY 123). Companion laboratory course (PY 125).

GEP Natural Sciences
Typically offered in Fall and Spring

PY 125 Astronomy Laboratory (1 credit hours)
Introduction to astronomical observing. Twelve exercises include astronomical instruments; the nature of light; Kepler's and Newton's laws of motion; the constellations, planets, binary stars, stellar clusters, and galaxies. Use of small telescopes to observe celestial objects.

Corequisite: PY 123 or 124
GEP Natural Sciences
Typically offered in Fall and Spring

PY 131 Conceptual Physics (4 credit hours)
Fundamentals of physics from a conceptual rather than a mathematical viewpoint. Applications of physics to everyday phenomena and experiences. Numerous demonstrations and discovery-based laboratory. Mechanics, properties of matter, heat, sound, electricity and magnetism, light and relativity.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 201 University Physics I (4 credit hours)
First course of three semester sequence for students majoring in physical and mathematical sciences. Calculus used throughout. Principles of classical Newtonian mechanics covered in detail.

Corequisite: MA 141. Credit is not allowed for both PY 201 and PY 205 or PY 211.
Typically offered in Fall only

PY 202 University Physics II (4 credit hours)
Second course of three semester sequence designed primarily for students majoring in physical and mathematical sciences. Calculus used throughout. Principles of electricity and magnetism covered in detail.

Prerequisite: PY 201, MA 141, Corequisite: MA 241. Credit is not allowed for both PY 202 and PY 208 or PY 211.
Typically offered in Spring only

PY 203 University Physics III (4 credit hours)
Third course of three semester sequence designed primarily for students majoring in physical and mathematical sciences. Calculus is used throughout. Principles of wave optics and modern physics are covered in detail.

Prerequisite: PY 202, MA 241, Corequisite: MA 242
Typically offered in Fall only

PY 205 Physics for Engineers and Scientists I (3 credit hours)
First semester of a two-semester sequence in introductory physics, with coordinated problem-solving experiences. A calculus-based study of mechanics, sound and heat. Credit not allowed for more than one of PY 205, PY 201, and PY 211.

Prerequisite: MA 141 with a grade of C- or better or MA 241PL. Credit is not allowed for both PY 205 and PY 201 or PY 211. Co-requisite: PY 206. ADD BOTH PY 205 and PY 206 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 206 Physics for Engineers and Scientists I Laboratory (1 credit hours)
Laboratory course to accompany the PY 205 lecture course. A calculus-based study of mechanics, sound and heat.

Prerequisite: MA 141 with a grade of C- or better or MA 241 Placement. Co-requisite: PY 205. ADD BOTH PY 205 and PY 206 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 208 Physics for Engineers and Scientists II (3 credit hours)
Second semester of a two-semester sequence in introductory physics. A calculus-based study of electricity, magnetism, optics and modern physics. Credit not allowed for more than one of PY 208,PY 202, and PY 212

Prerequisite: C- or better in PY 205 and C- or better in MA 241. Credit is not allowed for both PY 208 and PY 202 or PY 212. Co-requisite: PY 209. ADD BOTH PY 208 and PY 209 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 209 Physics for Engineers and Scientists II Laboratory (1 credit hours)
Laboratory course to accompany the PY 208 lecture course. A calculus-based study of electricity, magnetism, optics and modern physics.

Pre-requisite: PY 205 with grade of C- or better, MA 241 with grade of C- or better, PY 206 with grade of C- or better. Co-requisite: PY 208. ADD BOTH PY 208 and PY 209 TO YOUR SHOPPING CART AND THEN ENROLL SIMULTANEOUSLY
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 211 College Physics I (4 credit hours)
First semester of a two-semester introductory sequence in non-calculus physics, with laboratory. Mechanics, heat, wave motion and sound. Credit not allowed for more than one of PY 211, PY 201 or PY 205

Prerequisite: MA 107 or 111 or 121 or 131 or 108 or 141 with a C- or better, or 480 on the SAT Subject Test in Mathematics Level 2 or the NCSU Math Skills Test, or 2 or better on an AP Calc exam. Credit is not allowed for both PY 211 & PY 201 or PY 205
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PY 212 College Physics II (4 credit hours)
Second semester of a two-semester introductory sequence in non-calculus physics, with laboratory. Electricity, and magnetism, light, modern physics. Credit not allowed for more than one of PY 212, PY 202, and PY 208

Prerequisite: PY 211 or PY 205. Credit is not allowed for both PY 212 and PY 202 or PY 208.
Typically offered in Fall, Spring, and Summer

PY 251 Introduction to Scientific Computing (3 credit hours)
An introductory course in scientific computing for the physical and mathematical sciences using python and other open-source tools. Using a problem-oriented approach, students will learn the basic computing skills needed to conduct scientific research and to prepare for upper-level courses in science and engineering. Topics will include algorithm development, numerical methods, elements of programming, data analysis, and data visualization.

Prerequisite: MA 241; Corequisite: PY 202 or PY 208
Typically offered in Fall and Spring

PY 252 Instrumental and Data Analysis for Physics (2 credit hours)
Digital data acquisition and lab computers (e.g. using LabView or MatLab) are tools used in nearly all current physics research labs. By using both analysis and thorough lab experimental investigation the student will learn basic skills with electronic devices (oscilloscope, power supplies, function generator, op-amps, high & low-pass filters, feedback circuits), electronic noise (measurement and analysis), and basic circuit construction methods (such as shielding/grounding, soldering).

Prerequisite: PY 202 or PY 208
Typically offered in Fall, Spring, and Summer

PY 299 Special Problems in Physics (1-3 credit hours)
Study in experimental or analytical topics in classical and modern physics.

Typically offered in Fall, Spring, and Summer

PY 301 Introduction to Quantum Mechanics (3 credit hours)
An introduction to wave mechanics and quantum phenomena including the Schroedinger equation for simple systems, the Hamiltonian operator, the use of commutator relations, and the application of angular momentum operators. Emphasis on mathematical tools used in wave mechanics, including complex numbers, function operators, eigenvalues and eigenvectors.

Prerequisite: C- or better in PY 203 or PY 407
Typically offered in Fall only

PY 328 Stellar and Galactic Astrophysics (3 credit hours)
Introduction to the study of stars, galaxies, and the universe. Stars and stellar evolution; interstellar medium; galaxies and galaxy clusters; cosmology. Recent developments in the understanding of neutron stars, black holes, active galaxies, quasars and inflationary cosmologies.

Prerequisite: PY 202 or PY 208
Typically offered in Fall only

PY 341 Relativity, Gravitation and Cosmology (3 credit hours)
Introduction to relativity, gravitation and cosmology in accordance with Einstein's special and general theories of relativity. Flat spacetime: Minkowski metric, time dilation, length contraction, doppler effect, twin paradox, and space travel. Curved spacetime: Schwarzchild metric, black holes and event horizons, particle and light motion, Global positioning system, precession of planetary orbits. Cosmology: hubble law, expansion of the universe, Friedman-Robertson-Walker metric, big bang, cosmological redshift, dark matter and dark energy.

Prerequisite: C- or better in PY 203 or PY 407
Typically offered in Spring only

PY 401 Quantum Physics I (3 credit hours)
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.

Prerequisite: Grade of C- or better in PY 411 and grade of C- or better in PY 203.
Typically offered in Spring only

PY 402 Quantum Physics II (3 credit hours)
An introduction to the basic principles of quantum physics with an emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles.

Prerequisite: C- or better in PY 401
Typically offered in Fall only

PY 407 Introduction to Modern Physics (3 credit hours)
Major developments in modern physics: special relativity, origin of the quantum theory, atomic and molecular structure, radioactivity, properties of nuclei. Credit not allowed for both PY 203 and PY 407

Prerequisite: MA 242, PY 208
Typically offered in Spring only

PY 411/PY 511 Mechanics I (3 credit hours)
First semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on single-particle dynamics: Elementary Newtonian mechanics, harmonic oscillator, central force motion, conservation laws, motion in non-inertial frames, Coriolis and centrifugal forces, Lagrangian dynamics, Hamilton's equations.

Prerequisite: C- or better in PY 203 or C- or better in PY 407 Co-requisite: MA 341
Typically offered in Spring only

PY 412/PY 512 Mechanics II (3 credit hours)
Second semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on dynamics of systems of particles and continua: Center of mass, collisions, rigid bodies, inertia tensor, principal axes, stress andstrain tensors, mechanical properties of fluids and solids; Waves in discrete and continuum systems, coupled oscillators, normal modes, elements of special relativity.

Prerequisite: C- or better in PY 411
Typically offered in Fall only

PY 413 Thermal Physics (3 credit hours)
An introduction to statistical mechanics and thermodynamics. The statistical study of physical systems emphasizing the connection between the statistical description of macroscopic systems and classical thermodynamics. Concepts of heat, internal energy, temperature and entropy. Classical and quantum statistical distributions.

Prerequisite: PY 203 or PY 407; Corequisite: MA 341
Typically offered in Spring only

PY 414/PY 514 Electromagnetism I (3 credit hours)
First semester of a two-semester sequence. An intermediate course in electromagnetic theory using the methods of vector calculus. Electrostatic field and potential, dielectrics, solution to Laplace's and Poisson's equations, magnetic fields of steady currents.

Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341
Typically offered in Fall only

PY 415/PY 515 Electromagnetism II (3 credit hours)
A continuation of PY 414. Electromagnetic induction, magnetic fields in matter, Maxwell's equations, wave guides, radiation.

Prerequisite: C- o better in PY 414
Typically offered in Spring only

PY 452 Advanced Physics Laboratory (3 credit hours)
Introduction to laboratory electronics and instrumentation. Experiments in mechanics; electromagnetism; electronics; optics; and atomic, nuclear, plasma and solid state physics. Senior Physics students only

Prerequisite: Senior standing, Physics Majors
Typically offered in Fall and Spring

PY 489/PY 589/ECE 489/ECE 589/MSE 489/MSE 589 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

PY 495 Special Topics in Physics (1-4 credit hours)
Special Topics in theoretical, experimental, or computational physics at the advanced undergraduate level. Course offerings vary from semester to semester. Course may be repeated if course content varies.

Typically offered in Fall, Spring, and Summer

PY 499 Independent Research in Physics (1-6 credit hours)
Study and research in physics. Topics for experimental or theoretical investigation. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PY 501 Quantum Physics I (3 credit hours)
Basic principles of quantum physics with emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles. PY 501 - first semester in two-semester sequence in quantum mechanics; PY 501 - second semester of sequence. Credit for both PY 401 and PY 501 is not allowed

Prerequisite: Graduate Level Status in Physics or Physics Departmental Approval
Typically offered in Spring only

PY 502 Quantum Physics II (3 credit hours)
Basic principles of quantum physics with emphasis on selected applications to atoms, molecules, solids, nuclei and elementary particles. PY 502 - second semester in two-semester sequence in quantum mechanics; PY 501, first semester of sequence. Credit for both PY 402 and PY 502 is not allowed.

Prerequisite: PY 501
Typically offered in Fall only

PY 506 Nuclear and Subatomic Physics (3 credit hours)
Introduction to nuclear and subatomic phenomena: properties of nuclear radiations and detectors, accelerators, nuclear forces and nuclear structure, elementary particles, fundamental symmetries and conservation laws.

Prerequisite: PY 203 or 407; PY 412
Typically offered in Fall only

PY 507 Elementary Particle Physics (3 credit hours)
Introduction to fundamental symmetries and dynamics of quarks and leptons. The Standard Model, Dirac equation, Feynman rules in QED and QCD, the Higgs mechanism and electroweak unification.

Prerequisite: PY 401 and PY 506
Typically offered in Spring only

PY 509 General Relativity (3 credit hours)
This course provides in-depth knowledge of general relativity covering: Einstein's equation, Schwarzschild metric, Kerr metric, Friedman-Robertson-Walker metric, Christoffel symbols, Killing vectors, Riemann curvature,and Ricci tensors. Theoretical computations are compared with experimental data including the precession rate of the perihelion for Mercury and the deflection in the solar eclipse, the geodelic affect and the frame dragging effect measured in Gravity Probe B experiment.

P: MA 401 and MA 405 and PY 412 and PY 415; R: Graduate Standing
Typically offered in Spring only

PY 511/PY 411 Mechanics I (3 credit hours)
First semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on single-particle dynamics: Elementary Newtonian mechanics, harmonic oscillator, central force motion, conservation laws, motion in non-inertial frames, Coriolis and centrifugal forces, Lagrangian dynamics, Hamilton's equations.

Prerequisite: C- or better in PY 203 or C- or better in PY 407 Co-requisite: MA 341
Typically offered in Spring only

PY 512/PY 412 Mechanics II (3 credit hours)
Second semester of a two-semester sequence in particle and continuum mechanics at the intermediate level. Focuses on dynamics of systems of particles and continua: Center of mass, collisions, rigid bodies, inertia tensor, principal axes, stress andstrain tensors, mechanical properties of fluids and solids; Waves in discrete and continuum systems, coupled oscillators, normal modes, elements of special relativity.

Prerequisite: C- or better in PY 411
Typically offered in Fall only

PY 514/PY 414 Electromagnetism I (3 credit hours)
First semester of a two-semester sequence. An intermediate course in electromagnetic theory using the methods of vector calculus. Electrostatic field and potential, dielectrics, solution to Laplace's and Poisson's equations, magnetic fields of steady currents.

Prerequisite: C- or better in PY 203 or C- or better in PY 407, and MA 341
Typically offered in Fall only

PY 515/PY 415 Electromagnetism II (3 credit hours)
A continuation of PY 414. Electromagnetic induction, magnetic fields in matter, Maxwell's equations, wave guides, radiation.

Prerequisite: C- o better in PY 414
Typically offered in Spring only

PY 516 Physical Optics (3 credit hours)
Physical optics with major emphasis on wave properties of light. Boundary conditions, interference and diffraction, optics of thin films, fiber optics and applications to absorption, scattering and laser operation. A background in Maxwell's equations and vector analysis required.

Prerequisite: PY 415
Typically offered in Fall only

PY 517 Atomic and Molecular Physics (3 credit hours)
The quantum mechanical treatment of structure and spectra for atoms and molecules. The hydrogen atom, helium atom, multielectron atoms, selection rules, diatomic and simple polyatomic molecules and nuclear magnetic resonance spectroscopy.

Prerequisite: PY 401, 412
Typically offered in Spring only

PY 519 Biological Physics (3 credit hours)
This course presents the application of physics principles and methods to problems in biological systems. Important biological molecules, their structures and their processes are introduced for physical scientists. Functional mechanisms are analyzed with concepts from thermodynamics, statistical mechanics, fluid mechanics, and electrostatics. Modern experimental methods and computational approaches to molecular and cellular level biological phenomena are emphasized.

Prerequisite: PY 413 or Graduate Standing
Typically offered in Spring only

PY 525 Computational Physics (3 credit hours)
Computational approach to physics problem solving using standard software relevant for physicists. Electrostatic potentials, data analysis, Monte Carlo simulations, Fourier optics, particle orbits, Schrodinger's equation. Examples and assignments for each topic chosen to complement other physics courses.

Prerequisite: CSC 112 or equivalent; Corequisite: of PY 401
Typically offered in Fall only

PY 528/NE 528 Introduction to Plasma Physics and Fusion Energy (3 credit hours)
Concepts in plasma physics, basics of thermonuclear reactions; charged particle collisions, single particle motions and drifts, radiation from plasmas and plasma waves, fluid theory of plasmas, formation and heating of plasmas, plasma confinement, fusion devices and other plasma applications.

Prerequisite: MA 401 and PY 208
Typically offered in Fall only

PY 529/NE 529 Plasma Physics and Fusion Energy II (3 credit hours)
This course expands on the treatment of plasmas as a system of coupled fluids and introduces the foundations of plasma kinetic theory. Derivation of the plasma kinetic equation and the Vlasov equation serve as the starting point to introduce the kinetic study of plasma systems. From this introduction of the governing equations for full kinetic treatment, methods for analyzing plasma response to electromagnetic and electrostatic perturbations using the linearized Vlasov model for uncorrelated plasmas are introduced. Kinetic stability of Vlasov plasmas is introduced and the Nyquist method is used to determine conditions for kinetic stability. The concept of correlated plasmas is then introduced through the introduction of reduced distribution functions and the BBGKY heirarchy. Finally, simple correlated systems and the Liouville model for two-system correlation is covered to look at the impact of particle correlation due to collisions and coulomb interaction.

Prerequisite: NE 528
Typically offered in Spring only

PY 543 Astrophysics (3 credit hours)
Basic physics necessary to investigate, from observational data, internal conditions and evolution of stars. The formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy, white dwarfs and neutron stars.

Prerequisite: PY 203 or 407; PY 411
Typically offered in Spring only

PY 552 Condensed Matter Physics I (3 credit hours)
Basic considerations of crystalline solids, metals, conductors and semiconductors.

Prerequisite: C- or better in PY 401
Typically offered in Spring only

PY 570/TE 570 Polymer Physics (3 credit hours)
Polymer microstructures, polymer solutions, polymer physical states (including amorphous polymers, crystalline polymers, polymer melts, melting of polymers, glass-transition, and other transitions), polymer blends, polymer mechanical properties, polymer viscoelasticity and flow, multicomponent polymer systems, and modern polymer topics. The physics of polymer fibers. Graduate standing or permission of instructor.

Typically offered in Fall only

PY 581 Matter & Interactions for Teachers I (3 credit hours)
First semester (mechanics) of a two-semester sequence intended to broaden and deepen in high school physics teachers their knowledge of introductory-level physics from a contemporary point of view. Includes an introduction to computational physics.Departmental permission required: normally restricted to in-service high school physics teachers.

Typically offered in Spring only

PY 582 Matter & Interactions for Teachers II (3 credit hours)
Second semester (electricity and magnetism) of a two-semester sequence intended to broaden and deepen in high school physics teachers their knowledge of introductory-level physics from a contemporary point of view. Includes an introduction to computational physics. Departmental permission required: normally restricted to in-service high school physics teachers. PY 581 prerequisite may be waived with strong background in physics and mathematics.

Typically offered in Fall only

PY 589/ECE 489/ECE 589/MSE 489/MSE 589/PY 489 Solid State Solar and Thermal Energy Harvesting (3 credit hours)
This course studies the fundamental and recent advances of energy harvesting from two of the most abundant sources, namely solar and thermal energies. The first part of the course focuses on photovoltaic science and technology. The characteristics and design of common types of solar cells is discussed, and the known approaches to increasing solar cell efficiency will be introduced. After the review of the physics of solar cells, we will discuss advanced topics and recent progresses in solar cell technology. The second part of the course is focused on thermoelectric effect. The basic physical properties, Seebeck coefficient, electrical and thermal conductivities, are discussed and analyzed through the Boltzmann transport formalism. Advanced subject such as carrier scattering time approximations in relation to dimensionality and the density of states are studied. Different approaches for further increasing efficiencies are discussed including energy filtering, quantum confinement, size effects, band structure engineering, and phonon confinement.

P: ECE 302 or E 304 or MSE 355 or PY 407
Typically offered in Spring only

PY 590 Special Topics In Physics (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged

Typically offered in Fall, Spring, and Summer

PY 599 Special Topics in Physics (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits arranged

Typically offered in Fall, Spring, and Summer

PY 601 Seminar (1 credit hours)
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.

Typically offered in Fall and Spring

PY 610 Special Topics (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged.

Typically offered in Fall and Spring

PY 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Spring only

PY 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PY 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PY 711 Advanced Quantum Mechanics I (3 credit hours)
Introduction to relativistic quantum theory of Dirac particles and the positron. Other topics including second quantization technique and its application to many-body problems, radiation theory and quantization of the electromagnetic field.

Prerequisite: MA 512, PY 782
Typically offered in Fall only

PY 712 Advanced Quantum Mechanics II (3 credit hours)
A general propagator treatment of Dirac particles, photons and scalar and vector mesons. Applications of Feynman graphs and rules illustrating basic techniques employed in treatment of electromagnetic, weak and strong interactions. Renormalization theory, the effects of radiative corrections and aspects of the general Lorentz covariant theory of quantized fields.

Prerequisite: PY 711
Typically offered in Spring only

PY 721 Statistical Physics I (3 credit hours)
Basic elements of kinetic theory and equilibrium statistical mechanics, both classical and quantum; applications of the techniques developed to various ideal models of noninteracting particles.

Prerequisite: PY 401, PY 413
Typically offered in Spring only

PY 722 Statistical Physics II (3 credit hours)
A continuation of PY 721, with emphasis on the static and dynamic properties of real (interacting) systems. Topics including equilibrium theory of fluids and linear response theory of time-dependent phenomena.

Prerequisite: PY 721
Typically offered in Fall only

PY 753 Condensed Matter Physics II (3 credit hours)
The properties of semiconductors, superconductors, magnets, ferroelectrics and crystalline defects and dislocations.

Prerequisite: PY 552
Typically offered in Fall only

PY 781 Quantum Mechanics I (3 credit hours)
Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics including approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum.

Prerequisite: MA 512; PY 411 or 414; Graduate standing
Typically offered in Fall only

PY 782 Quantum Mechanics II (3 credit hours)
Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics including approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum.

Prerequisite: MA 512; PY 411 or 414; Graduate standing
Typically offered in Spring only

PY 783 Advanced Classical Mechanics I (3 credit hours)
Introduction to theoretical physics in preparation for advanced study. Emphasis on classical mechanics, special relativity and the motion of charged particles. Topics including variational principles, Hamiltonian dynamics and canonical transformation theory, structure of the Lorentz group and elementary dynamics of unquantized fields.

Prerequisite: MA 512, PY 412, PY 414; Graduate standing
Typically offered in Fall only

PY 785 Advanced Electricity and Magnetism I (3 credit hours)
Topics including techniques for solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges.

Prerequisite: PY 415; Graduate standing
Typically offered in Fall only

PY 786 Advanced Electricity and Magnetism II (3 credit hours)
Topics including techniques for solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges.

Prerequisite: PY 415; Graduate standing
Typically offered in Spring only

PY 790 Special Topics in Physics (1-99 credit hours)

PY 801 Seminar (1 credit hours)
Reports on topics of current interest in physics. Several sections offered so that students with common research interests may be grouped together.

Typically offered in Fall and Spring

PY 810 Special Topics In Physics (1-6 credit hours)
Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Credits Arranged

Typically offered in Fall and Spring

PY 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Spring only

PY 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Spring only

PY 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PY 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PY 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Physiology (PHY)

PHY 452/ANS 452/ANS 552/PHY 552 Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit will not be given for both ANS 452 and ANS (PHY) 552.

Prerequisite: ANS 220
Typically offered in Fall only

PHY 503 General Physiology I (3 credit hours)
Physiology is the study of the how living systems function from the molecular to organismal level. As such, this course will build on your knowledge of anatomy, biochemistry, and cell biology and also presumes a working knowledge of the basics of college level physics and chemistry. Students will learn the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body and be able to integrate knowledge and concepts from various organ systems to explain function in the human body. In this course, we will address cellular, neural, muscular, and gastrointestinal physiology in humans.

P: BCH451 and BCH553 (or equivalents) and one year each of college-level physics and chemistry
Typically offered in Fall only

PHY 504 General Physiology II (3 credit hours)
Physiology is the study of the how living systems function from the molecular to organismal level. As such, this course will build on your knowledge of anatomy, biochemistry, and cell biology and also presumes a working knowledge of the basics of college level physics and chemistry. Students will learn the fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body and be able to integrate knowledge and concepts from various organ systems to explain function in the human body. In this course, we will address cardiovascular, respiratory, and renal physiology in humans.

P: BCH451 and BCH553 (or equivalents) and one year each of college-level physics and chemistry
Typically offered in Spring only

PHY 505 Pathophysiology (2 credit hours)
Pathophysiology is one of the bridge courses between basic medical science and clinical medicine: it plays an important role in basic medical courses, concerning the etiology and pathogenesis of disease as well as the mechanisms of functional and metabolic alterations in disease. Different from pathology, which emphasizes the morphological changes, pathophysiology focuses on the functional and metabolic alterations and mechanisms underlying the development of diseases. This discussion- and presentation-based course will focus on developing written and oral communication skills through the use of case studies.

R: Physiology Program Students Only
Typically offered in Spring only

PHY 524/PO 524/ZO 524 Comparative Endocrinology (3 credit hours)
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

Prerequisite: BIO 421 or PO 405
Typically offered in Spring only

PHY 552/PHY 452/ANS 452/ANS 552 Comparative Reproductive Physiology and Biotechnology (3 credit hours)
Comparative approach to examining aspects of reproductive physiology in selected vertebrate species. Detailed examination of current reproductive biotechnologies and ethical issues associated with the application of reproductive biotechnologies. Credit will not be given for both ANS 452 and ANS (PHY) 552.

Prerequisite: ANS 220
Typically offered in Fall only

PHY 595 Special Topics in Physiology (1-6 credit hours)
The study of special problems and selected topics of current interest in physiology and related fields.

Typically offered in Spring only

PHY 601 Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Prerequisite: Graduate standing
Typically offered in Spring only

PHY 610 Special Topics In Physiology (1-6 credit hours)
The study of special problems and selected topics of current interest in physiology and related fields.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PHY 620 Special Problems In Physiology (1-6 credit hours)
Credits Arranged

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PHY 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PHY 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Summer only

PHY 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PHY 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PHY 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PHY 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PHY 702/ANS 702 Reproductive Physiology of Mammals (3 credit hours)
Survey of reproductive strategies among vertebrates; in-depth coverage of mammalian reproductive physiology; gametogenesis, fertilization, embryonic and fetal development, parturition, puberty, neuroendrocrine control mechanisms in male and female mammals.

Prerequisite: ZO 421
Typically offered in Fall and Spring

PHY 764/CBS 764/NTR 764 Advances in Gastrointestinal Pathophysiology (3 credit hours)
This course will focus on advanced gastrointestinal physiology and the pathophysiology of deseases of relevance to scientsts involved in animal-related research. In particular, the course will cover the pathophysiology of ulceration, infectious diarrhea, ischemia, motility disorders, and inflammatory diseases of the gut. An in-depth review paper will be required based on recent literature rgarding a specific gastrointestinal disease.

Prerequisite: PHY 503, PHY 504
Typically offered in Fall only

PHY 780/ANS 780 Mammalian Endocrinology (3 credit hours)
Mammalian endocrine system with emphasis on ontogeny and anatomy of key organs; synthesis and action of hormones. Role of hormones in regulation of physiological processes such as metabolism, exocrine function, digestion, ion balance, behavior, lactation, growth and reproduction.

Prerequisite: BCH 451, ZO 421

PHY 795 Special Topics in Physiology (1-9 credit hours)
The study of special problems and selected topics of current interest in physiology and related fields.

Typically offered in Fall and Spring

PHY 801 Physiology Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Prerequisite: Graduate standing
Typically offered in Spring only

PHY 810 Speical Topics In Physiology (1-4 credit hours)
The study of special problems and selected topics of current interest in physiology and related fields.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PHY 820 Special Problems In Physiology (1-6 credit hours)
Credits Arranged

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PHY 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planing for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Summer only

PHY 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PHY 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PHY 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PHY 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PHY 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Plant Biology (PB)

PB 103 Perspectives on Botany (1 credit hours)
Orientation to modern botany, including discussions of historical background, relation to other sciences, the nature of modern subdisciplines, professionalism and ethics, local resources of personnel and facilities, educational opportunities, and career possibilities.

Typically offered in Fall only

PB 200 Plant Life (4 credit hours)
An introduction to the structure, processes, and reproduction of higher plants, including the diversity of the plant kingdom and principles of inheritance, ecology, and evolution. Students cannot receive credit for both PB 200 and PB 250.

GEP Natural Sciences
Typically offered in Fall and Spring

PB 205 Our Green World (3 credit hours)
Awareness and understanding of plants in the world for the non-science student. Essential fundamental concepts of plant structure, growth, processes, uses, biotechnology, evolution, environmental issues and ecology. Short field trips will be held that may require students to provide their own transportation. Credit cannot be received for both PB 205 and (PB 200 or PB 250).

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

PB 208/AEE 208/ANS 208 Agricultural Biotechnology: Issues and Implications (3 credit hours)
Trends and issues of agricultural biotechnology in today's society are addressed while covering the basic biological science behind the technology. Applications of and policy issues associated with plant, animal, and environmental biotechnology used in the agricultural industry are examined from an interdisciplinary approach.

Prerequisite: (BIO 105 or BIO 115 or BIO 181 or BIO 183)
GEP Interdisciplinary Perspectives
Typically offered in Spring only

PB 213 Plants and Civilization (3 credit hours)
This course covers plant use in ancient civilizations, including the economic, social, political, religious, culinary and medical roles of plants and plant products.Plant use in ancient cultures, including but not limited to, Amazonian, Celtic, Chinese, Egyptian, Greek, Inca, Indian, Maya, Mesopotamian, Nubian, Persian, and Roman will be discussed. Topics include foods, beverages, medicines, fibers, construction materials, psychoactive drugs, and religious symbols.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PB 215 Medicinal Plants (3 credit hours)
Plants and their derived pharmaceuticals in Western medicine and in herbal medicine.

Prerequisite: CH 101 and any one of the following courses: BIO 125,BIO 181,PB 200,ZO 150,ZO 160
Typically offered in Fall only

PB 219 Plants in Folklore, Myth, and religion (3 credit hours)
The structural and functional biology of plants and cultural inclusions in folklore, myth, and religion. The myth/religion-plant-human culture nexus. Mythical and religious themes covered, but not limited to, are: the world tree and cosmic order; plants and the creation of Earth; the unity of plants and divine entities; the tree of life; life-giving waters and human immortality; human descent from plants; origin of food plants from humans; plants of witchcraft and magic; psychoactive plants and access to deities; solidarity between humans and plants; death and resurrection of plants and humans.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

PB 220 Local Flora (3 credit hours)
Structural terminology of vascular plants, field identification of plant species by sight and using taxonomic keys, description of natural community types, including their soil and topographic features. Two Saturday field trips required.

Prerequisite: BIO 105 or BIO 181 or PB 200
GEP Natural Sciences
Typically offered in Fall only

PB 250 Plant Biology (4 credit hours)
An introduction for Life Science majors to the ecology, structure, function, processes, reproduction and evolution of higher plants. Students may not receive credit for both PB 200 and PB 250.

Prerequisite: BIO 181 and BIO 183
Typically offered in Fall only

PB 277 Space Biology (3 credit hours)
Overview of the biology of plants, animals, and humans in the space environment, including gravitational biology, aerospace medicine, astrobiology, search for extraterrestrial life, terraforming, and life support.

Prerequisite: BIO 105 or BIO 181 or BIO 183 or PB 200
GEP Natural Sciences
Typically offered in Fall only

PB 295 Special Topics in Botany (1-4 credit hours)
Trial offerings of new or experimental courses in Botany at the early undergraduate level.

Typically offered in Fall, Spring, and Summer

PB 321 Introduction to Whole Plant Physiology (3 credit hours)
Physiology of higher plants with emphasis on whole plant aspects including structure-function relationships, water and solute movement, energy sources and needs, plant growth and development, and the impact of plant physiology findings on agriculture. Students cannot receive credit for both PB 321 and PB 421.

Prerequisite: (BIO 183 or PB 200 or PB 250) and CH 101/102
Typically offered in Spring only

PB 325 Culinary Botany (3 credit hours)
This course explores the ethnobotany, taxonomic diversity, and unique physical and chemical characteristics of important food and beverage plants used by peoples in different regions of the world. After an introduction to plant domestication and agricultural origins, most course weeks are spent examining the culturally significant edible flora of a different geographic region, combining short lectures on the botany of selected species, discussions about the uses of plant biocultural diversity, and, when feasible, hands-on activities where course participants can sample plant-based foods from each region. One Saturday field trip required.

Prerequisite: CS 213 or HS 201 or PB 200 or PB 250
Typically offered in Fall only

PB 345 Economic Botany (3 credit hours)
This course covers plants of economic importance that have been valued by societies regionally, nationally and globally from the modern era to the present day. Topics include, but are not limited to, plant species used as food, spices, beverages, oils, fibers, paper, dyes, perfumes, body care, construction materials, fuels and ornamentals. Aspects related to the botany and ethnobotany of economically important plant species will be discussed including taxonomy, anatomy, physiology, ecology, conservation, human uses, social and environmental issues, and roles in the economy.

Prerequisite: BIO 181 or PB 200 or PB 250
Typically offered in Spring only

PB 346 Economic Botany Lab (1 credit hours)
This lab course explores plants and plant products of economic importance through hands-on activities. Aspects related to the botany and ethnobotany of economically important plant species will be covered including taxonomy, anatomy, physiology, ecology, conservation, human uses, social and environmental issues, and roles in the economy.

Prerequisite: BIO 181 or PB 200 or PB 250; Co-requisite: PB 345
Typically offered in Spring only

PB 360/AEC 360 Ecology (4 credit hours)
The science of ecology, including factors which control distribution and population dynamics of organisms, structure and function of biological communities, and energy flow and nutrient cycling in ecosystems; contrasts among the major biomes; and principles governing ecological responses to global climatic and other environmental changes.

Prerequisite: C- or better in BIO 181
Typically offered in Fall only

PB 400 Plant Diversity and Evolution (4 credit hours)
Diversity, morphology, taxonomy, and evolutionary history of living and fossil plants including fungi, algae, bryophytes, pteridophytes, gymnosperms, and angiosperms. Two one-day weekend field trips required.

Prerequisite: BIO 181 or PB 200 or PB 250
Typically offered in Spring only

PB 403/PB 503 Systematic Botany (4 credit hours)
The course introduces basic and contemporary systematic principles and methods as applied to vascular plants, with emphasis on flowering plants. It covers classification, identification, phylogenetics, and molecular approaches, and surveys important and common plant families representing major groups of vascular plants.

Prerequisite: PB 200, PB 250, BIO 183, Junior standing
Typically offered in Spring only

PB 407/PB 507 Medical Ethnobotany (3 credit hours)
This course covers traditional medical systems from a diversity of ancient and modern cultures, with an emphasis on the medicinal plants utilized within these healing traditions. Humans, as well as a number of other species, have utilized plants and other products from nature to treat their physical and spiritual ailments since prehistoric times. In addition to covering medicinal plant species and their known bioactivity, other topics will include traditional diagnostic techniques, complementary healing modalities, beliefs regarding health and illness, treatment and causes of spiritual diseases, food and spices as medicine, and ethical considerations in ethnobotanical research.

Prerequisite: (BIO 181 or PB 200 or PB 250) and (Junior or Senior)
Typically offered in Spring only

PB 413/PB 513 Plant Anatomy (2 credit hours)
Organelles, cells, tissues and organs of flowering plants and selected gymnosperms. Emphasis placed on developmental patterns and structural adaptations for survival. Laboratory focuses on dissection, histochemistry, and imaging of plant cells and tissues. Students cannot reserve credit for both PB 413 and PB 513.

Prerequisite: PB 200 or PB 250 or PB 321 or PB 421
Typically offered in Spring only

PB 421 Plant Physiology (3 credit hours)
Physiology of higher plants with emphasis on biochemical, cell biological and molecular aspects of how plants function. Unique aspects of regulation of plant metabolism including photosynthesis, respiration, nitrogen fixation, cell wall biosynthesis, growth and stress responses will be emphasized. The course is intended for students interested in postgraduate studies in plant biology. Students cannot receive credit for both PB 321 and PB 421.

Prerequisite: BIO 183 or ZO 160, or PB 200 and CH 220 or CH 221 or CH 225
Typically offered in Fall only

PB 445/PB 545 Paleobotany (4 credit hours)
Morphologic, taxonomic, geologic and evolutionary relationships of fossil plants; emphasis on vascular plants; discussions of taphonomy, biogeography and palynology. Requires weekend field trips at student expense. Credit will not be allowed for both BO 445 and BO 545.

Prerequisite: BIO 181 or MEA 102

PB 450/PB 550 Plant Ecology (3 credit hours)
This course introduces students to the principles and methods of plant ecology. Topics include how individual plants extract resources from their environments; population dynamics and plant life histories; species interactions in communities; and global change ecology. The course emphasizes distinctive ways that plant natural history affects their ecology while also illustrating how plants can be ideal systems for studying general ecological problems. Undergraduate students gain hands-on ecological experience by gathering real data through field activities, and all students design independent research proposals.

Prerequisite: AEC/PB 360 or FOR 260
Typically offered in Spring only

PB 464/PB 564 Rare Plants of North Carolina (3 credit hours)
This course provides a taxonomic survey of the rare plants of North Carolina, focusing primarily on federally- and secondarily on state-listed species. Particular attention will be placed on: (1) the identification of rare species, their congeners, and morphologically similar species, (2) the biogeography of rare species, (3) optimum survey windows, and (4) the conservation biology of select taxa. Two Saturday field trips required. Junior level or higher. Students cannot receive credit for both PB 464 and PB 564.

Prerequisite: One of the following: (PB 200, PB220, PB 403, or PB 405)
Typically offered in Fall only

PB 480/PB 580 Introduction to Plant Biotechnology (3 credit hours)
Introduction to gene cloning, plant tissue culture and transformation, and the development of agriculturally important transgenic traits. Critical thinking, case studies, and discussions are used to examine global approaches to the regulation and risks of genetically-modified organisms, plant and gene patents, and the consequences of these factors on food soverienty and trade. Students cannot receive credit for both PB 480 and PB 580.

Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
Typically offered in Fall only

PB 481/BIT 481 Plant Tissue Culture and Transformation (2 credit hours)
Basic techniques in plant tissue culture and transformation. Empirical approaches to techniques in plant tissue culture, designing transgenes for expression in specific plant cell organelles and tissues, use of reporter genes to optimize transformation, and troubleshooting transformation. Laboratory sessions provide hands-on experience with plant tissue culture and transformation. Use of reporter genes, fluorescence microscopy and digital imaging. Half semester course, first part.

Typically offered in Spring only

PB 488/ECE 488/PB 588/ECE 588 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only

PB 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PB 493 Plant Biology Supervised Undergraduate Research Experience (1-3 credit hours)
This course provides students with a faculty-supervised research experience in Plant Biology that utilizes campus facilities and resources. A minimum of 45 hours of research activity must be completed for each credit hour earned. A maximum number of three credit hours, equivalent to 135 hours of research activity, may be earned per semester. Students must initiate contact and arrangements for research experience with prospective faculty mentors. To enroll, students are required to submit a completed PB 493 course contract that is approved by the faculty mentor and the Director of Plant Biology Undergraduate Programs. Students must submit a written midterm report and give an oral presentation on their research in addition to completing the tasks specified in the approved contract.

Typically offered in Fall, Spring, and Summer

PB 495 Special Topics in Plant Biology (1-4 credit hours)
Offered as needed to present material not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PB 501/MB 501/PP 501 Biology of Plant Pathogens (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.

Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

PB 503/PB 403 Systematic Botany (4 credit hours)
The course introduces basic and contemporary systematic principles and methods as applied to vascular plants, with emphasis on flowering plants. It covers classification, identification, phylogenetics, and molecular approaches, and surveys important and common plant families representing major groups of vascular plants.

Prerequisite: PB 200, PB 250, BIO 183, Junior standing
Typically offered in Spring only

PB 507/PB 407 Medical Ethnobotany (3 credit hours)
This course covers traditional medical systems from a diversity of ancient and modern cultures, with an emphasis on the medicinal plants utilized within these healing traditions. Humans, as well as a number of other species, have utilized plants and other products from nature to treat their physical and spiritual ailments since prehistoric times. In addition to covering medicinal plant species and their known bioactivity, other topics will include traditional diagnostic techniques, complementary healing modalities, beliefs regarding health and illness, treatment and causes of spiritual diseases, food and spices as medicine, and ethical considerations in ethnobotanical research.

Prerequisite: (BIO 181 or PB 200 or PB 250) and (Junior or Senior)
Typically offered in Spring only

PB 513/PB 413 Plant Anatomy (2 credit hours)
Organelles, cells, tissues and organs of flowering plants and selected gymnosperms. Emphasis placed on developmental patterns and structural adaptations for survival. Laboratory focuses on dissection, histochemistry, and imaging of plant cells and tissues. Students cannot reserve credit for both PB 413 and PB 513.

Prerequisite: PB 200 or PB 250 or PB 321 or PB 421
Typically offered in Spring only

PB 545/PB 445 Paleobotany (4 credit hours)
Morphologic, taxonomic, geologic and evolutionary relationships of fossil plants; emphasis on vascular plants; discussions of taphonomy, biogeography and palynology. Requires weekend field trips at student expense. Credit will not be allowed for both BO 445 and BO 545.

Prerequisite: BIO 181 or MEA 102
Typically offered in Spring only

PB 550/PB 450 Plant Ecology (3 credit hours)
This course introduces students to the principles and methods of plant ecology. Topics include how individual plants extract resources from their environments; population dynamics and plant life histories; species interactions in communities; and global change ecology. The course emphasizes distinctive ways that plant natural history affects their ecology while also illustrating how plants can be ideal systems for studying general ecological problems. Undergraduate students gain hands-on ecological experience by gathering real data through field activities, and all students design independent research proposals.

Prerequisite: AEC/PB 360 or FOR 260
Typically offered in Spring only

PB 559 Plant Water Relations (2 credit hours)
Physical and biological mechanisms that govern water uptake, water transport, transpiration, and plant responses to drought; constraints and tradeoffs that limit evolution and artificial selection of drought tolerance; methods for studying water relations. Weekly lecture and paper discussions will draw upon examples from both crop and wild plants.

Typically offered in Spring only

PB 564/PB 464 Rare Plants of North Carolina (3 credit hours)
This course provides a taxonomic survey of the rare plants of North Carolina, focusing primarily on federally- and secondarily on state-listed species. Particular attention will be placed on: (1) the identification of rare species, their congeners, and morphologically similar species, (2) the biogeography of rare species, (3) optimum survey windows, and (4) the conservation biology of select taxa. Two Saturday field trips required. Junior level or higher. Students cannot receive credit for both PB 464 and PB 564.

Prerequisite: One of the following: (PB 200, PB220, PB 403, or PB 405)
Typically offered in Fall only

PB 570 Plant Functional Ecology (3 credit hours)
Mechanisms by which plants interact with their environment, with an emphasis on the role of physiological, morphological, and life history traits, and the evolution of these traits.

Prerequisite: PB/BIO 360
Typically offered in Fall only

PB 575/MB 575/PP 575 Introduction to Mycology (4 credit hours)
A survey of the fungal kingdom in context of phyla and classes. Systematics, ecology, biology and utilization. Illustrative material, cultural techniques in laboratories. Collection and paper required.

Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

PB 580/PB 480 Introduction to Plant Biotechnology (3 credit hours)
Introduction to gene cloning, plant tissue culture and transformation, and the development of agriculturally important transgenic traits. Critical thinking, case studies, and discussions are used to examine global approaches to the regulation and risks of genetically-modified organisms, plant and gene patents, and the consequences of these factors on food soverienty and trade. Students cannot receive credit for both PB 480 and PB 580.

Prerequisite: BCH 454 or BIT 410 or CS 211 or GN 311 or PB/BIO 414 or PB 421.
Typically offered in Fall only

PB 588/ECE 588/PB 488/ECE 488 Systems Biology Modeling of Plant Regulation (3 credit hours)
This course provides an introduction to the field of systems biology with a focus on mathematical modeling, gene regulatory network and metabolic pathway reconstruction in plants. Students will learn how to integrate biological data with mathematical, statistical, and computational approaches to gain new insights into structure and behavior of complex cellular systems. Students are expected to have a minimal background in calculus and basic biology. The course will build on these basic concepts and provide all students, regardless of background or home department, with the fundamental biology, mathematics, and computing knowledge needed to address systems biology problems.

Prerequisite: MA 131 or MA 141
Typically offered in Fall only

PB 595 Special Topics in Plant Biology (1-4 credit hours)
The study of special problems and selected topics of current interest in plant biology and related fields.

Typically offered in Fall, Spring, and Summer

PB 601 Botany Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

PB 620 Special Problems In Botany (1-6 credit hours)
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

PB 624 Topical Problems (1-4 credit hours)
Discussions and readings on problems of current interest in fields of ecology, anatomy and morphology, taxonomy, plant physiology and cell biology. May be repeated with a change in topic for a maximum of six credits.

Typically offered in Fall and Spring

PB 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PB 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 690 Master's Examination (1-9 credit hours)
For students in non-thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 695 Master's Thesis Research (1-9 credit hours)
Thesis Research.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's Student
Typically offered in Summer only

PB 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's Student
Typically offered in Fall, Spring, and Summer

PB 704 Plant Nomenclature (1 credit hours)
A practical foundation in plant nomenclature and nomenclatural references. Emphasis on the evolution of international rules for naming plant taxa and their application in both wild and cultivated plants. Nomenclature applications used in patents, cultivar releases and journal articles. Taught mid-semester. Taught five weeks of semester.

Typically offered in Spring only

PB 733 Plant Growth and Development (3 credit hours)
Advanced course in plant physiology covering plant growth, development, differentiation, senescence and biological control mechanisms.

Prerequisite: PB(ZO) 414 or PB 421, organic chemistry
Typically offered in Spring only

PB 751 Advanced Plant Physiology I (3 credit hours)
Cellular mechanisms and regulatory features related to plant respiration, photosynthesis, sulfur metabolism, nitrogen fixation and metabolism, and signal transduction. One of two courses covering field of plant physiology.

Prerequisite: PB 421
Typically offered in Fall only

PB 761/BCH 761/GN 761 Advanced Molecular Biology Of the Cell (3 credit hours)
An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

Typically offered in Spring only

PB 774/MB 774 Phycology (3 credit hours)
Introduction to taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention to local freshwater flow and physiology of selected species in relation to algal blooms, water quality and nutrient loading in aquatic habitats.

Typically offered in Spring only

PB 780 Plant Molecular Biology (3 credit hours)
Molecular analysis of plant growth and development. Molecular techniques and their application to understanding control of gene expression in plants.

Prerequisite: BCH 451, GN 411
Typically offered in Fall only

PB 795 Special Topics Botany (1-6 credit hours)
The study of special problems and selected topics of current interest in botany and related fields.

Typically offered in Fall and Spring

PB 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

PB 820 Special Problems (1-6 credit hours)
Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Credits Arranged.

Typically offered in Fall, Spring, and Summer

PB 824 Topical Problems (1-4 credit hours)
Discussions and readings on problems of current interest in fields of ecology, anatomy and morphology, taxonomy, plant physiology and cell biology. May be repeated with a change in topic for a maximum of six credits.

Typically offered in Fall and Spring

PB 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

PB 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

PB 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PB 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PB 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral Student
Typically offered in Summer only

PB 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

Plant Pathology (PP)

PP 144/HS 144 Weeds & Diseases of Ornamentals (3 credit hours)
The objective of this course is to give students a fundamental and practical understanding of weed, disease, and pesticide management in the ornamental industries in North Carolina. Agricultural Institute students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 150 Introduction to Plant Molecular Biology (3 credit hours)
Hands-on introduction to modern molecular biology techniques. Isolation of SNA from tobacco leaves, isolating a plant gene through polymerase chain reaction (PCR), cloning DNA fragments in plasmid vectors, bacterial transformation and plasmid DNA purification, restriction digestion and gel electrophoresis, gene transfer and expression of reporter genes in plant cell lines through a biolistic gene gun. Field trips, poster assignment and poster presentation are mandatory. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) and other pre-college, transitional and early-college programs. Students must have no more than 30 credit hours. Deparment approval required.

Typically offered in Summer only

PP 154/CS 154 Turf Weed and Disease Management (3 credit hours)
General principles in turfgrass weed and disease development and management programs. Different weeds, their life cycles, management techniques, and factors affecting herbicide application performance will be covered. Students will learn the causes, development, identification and management of turfgrass diseases. Laboratory includes weed identification and herbicide application methods. Certain laboratory exercises will require personal transportation to Lake Wheeler Road Turf Field Lab unless otherwise specified by the lab instructors. The course is restricted to AGI students only.

Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 155 Diseases of Ornamentals and Turfgrasses (3 credit hours)
Causes, development, identification and management of diseases of greenhouses and landscape ornamentals and turfgrasses. WARFIELD

Requisite: Agricultural Institute Only
Typically offered in Fall only

PP 222 Kingdom of Fungi (3 credit hours)
Influence and impact of fungi in our world. The role of fungi in history, ecology, medicine, human and plant diseases, industry, food, and politics. Mushrooms, molds, mildews, and symbiosis.

Prerequisite: BIO 105 or 106 or 140 or 181 or 183 or PB 200 or 215 or 219 or 220 or 250 or MB 200
GEP Natural Sciences
Typically offered in Fall and Spring

PP 232 Big Data in Your Pocket: Call it a Smartphone (3 credit hours)
Data have been, are, and will be collected in every scientific discipline. Data provide a foundation to evaluate hypotheses and advance knowledge. For centuries scientists have collected data and built models separately with methods and principles defined in their disciplines. Modern technological advances have resulted in a data revolution. Data now come fast in all forms and in high volumes, presenting both new challenges and opportunities in many disciplines. In this course we will discuss how data is collected and visually summarized and how modern technology has allowed for the collection of big data, resulting in a revolution in the way we live, work, and think.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

PP 241 The Worm's Tale: Parasites In Our Midst (3 credit hours)
This is a 3 credit hour survey course on the impact of parasites on society, including development and exploration, wars and expansion, agriculture, health and medicine, economic impacts, political impacts, and attempts at control/management. From the fiery serpent to the scourge of malaria, parasitic organisms have played a significant, and sometimes pivotal role in the development and progress of human society. This course presents an overview that provides students the necessary information and resources to understand this ubiquitous and critically important group of organisms. Parasites represent a significant hurdle to overcome as global society continue to move forward.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

PP 315 Principles of Plant Pathology (4 credit hours)
Fundamental principles of plant pathology with emphasis on disease etiology, nature of pathogenesis, ecology of host/parasite interaction, epidemiology of plant diseases, current strategies and practices for integrated disease control.

Typically offered in Fall and Spring

PP 318/FOR 318 Forest Pathology (3 credit hours)
Major diseases of forest trees and deterioration of wood products emphasizing principles of plant pathology; diagnosis; nature, physiology, ecology, and dissemination of disease-causing agents; mechanisms of pathogenesis; epidemiology and environmental influences; principles and practices of control.

Prerequisite: PB 200
Typically offered in Fall and Spring

PP 470/CS 470/ENT 470 Advanced Turfgrass Pest Management (2 credit hours)
Characteristics and ecology of turfgrass weed, insect, and disease pests; identification and diagnosis of turfgrass pests, strategies for managing pests including cultural, mechanical, biological, and chemical methods; development of integrated pestmanagement programs, characteristics and modes of action for herbicides, insecticides, fungicides, and plant growth regulators; behavior and fate of pesticides in soil; and the development and management of pesticide resistant pest populations.

Prerequisite: C- or better in CS 200
Typically offered in Spring only

PP 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

PP 493 Special Problems in Plant Pathology (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall and Spring

PP 495 Special Topics in Plant Pathology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PP 501/PB 501/MB 501 Biology of Plant Pathogens (3 credit hours)
Biology of microbes that cause plant diseases. The ecology, genetics, physiology, taxonomy, and mechanisms of parasitism, pathogenicity and virulence of bacteria (and other prokaryotes), fungi (and oomycetes), nematodes, and viruses that cause plant diseases. Prepares graduate students for advanced courses in plant pathology, host-parasite interactions, and provides a knowledge base for students in other disciplines involved with plant pathogens or who seek to broaden their knowledge of microbes.

Prerequisite: PP 315, or PP 318, or an introductory course in microbiology
Typically offered in Fall only

PP 502/CS 502/HS 502 Plant Disease: Methods & Diagnosis (2 credit hours)
Introduction to the basic principles of disease causality in plants and the methodology for the study and diagnosis of plant diseases caused by fungi. Identification of plant-pathogenic fungi. Research project, disease profiles and field trips arerequired.

Prerequisite: PP 315
Typically offered in Fall only

PP 506 Epidemiology and Plant Disease Control (3 credit hours)
Consideration of fundamental concepts and principles of epidemiology as applied to modern strategies of plant disease control. Special consideration given to evaluation of current techniques for control of fungal, bacterial, viral and nematode pathogens in an integrated crop protection system.

Prerequisite: PP 315 or PP 318
Typically offered in Spring only

PP 575/PB 575/MB 575 Introduction to Mycology (4 credit hours)
A survey of the fungal kingdom in context of phyla and classes. Systematics, ecology, biology and utilization. Illustrative material, cultural techniques in laboratories. Collection and paper required.

Prerequisite: BS 125 or BS 181 and 183 or BO 200 or PP 315 or PP 318
Typically offered in Fall only

PP 590 Special Topics (1-3 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 601 Seminar (1 credit hours)
Discussion of assigned phytopathological topics.

Typically offered in Fall and Spring

PP 610 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 615 Advanced Special Topics in Plant Pathology (1-6 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Prerequisite: PP 501, 502, Corequisite: ST 511
Typically offered in Fall only

PP 620 Special Problems (1-6 credit hours)
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

Typically offered in Fall and Spring

PP 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

PP 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring only

PP 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

PP 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall and Spring

PP 696 Summer Thesis Res (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Typically offered in Summer only

PP 699 Master's Thesis Preparation (1-9 credit hours)
Original research in plant pathology.

Prerequisite: Graduate standing
Typically offered in Spring only

PP 707 Plant Microbe Interactions (3 credit hours)
Fundamental concepts and current status of research on the physiology, biochemistry and molecular biology of host-pathogen interactions during plant disease. Topics include recognition, penetration and colonization, pathogenicity and virulence determinants, resistance mechanisms, sign transduction, programmed cell death, and other current topics. Information presented in context of virual-, bacterial-, fungal-and nematode-plan interactions.Credit cannot be received for both PP 507 and PP 707

Prerequisite: PP 501
Typically offered in Spring only

PP 715/MB 715 Applied Evolutionary Analysis of Population Genetic Data (3 credit hours)
This course will introduce nonparametric and model-based methods for making inferences on population processes (mutation, migration, drift, recombination, and selection). The goal is to provide a conceptual overview of these methods and hands-on training on how to implement and interpret the results. Sample data sets in computer laboratories will integrate summary statistic, cladistic, coalescent, and bayesian approaches to examine population processes in different pathosystems with specific emphasis on eukaryotic microbes, viruses and bacteria.

PP 727/ENT 727 Ecology of Soil Ecosystems (3 credit hours)
This course will focus on the interactions between soil organisms and their environment, and the ecological consequences of these diverse complex interactions. In particular, it will explore the scientific evidence that illustrates links between soil organisms, ecosystem functioning and the quality of air and water systems, and examine why and how the related research was conducted. This course will bring together theory and research trends from distinct subject areas: soil microbiology, entomology and ecosystem ecology.

Prerequisite: One course in: (SSC 332, SSC 511, SSC 521, or SSC 532), or ecology (BO 360 or CS 430), or microbiology (MB 351), or consent of instructor.
Typically offered in Spring only

PP 755 Plant Disease Resistance: Mechanisms and Applications (3 credit hours)
This class deals with the major concepts in plant disease resistance: Its molecular and biochemical bases, its effectiveness and methods of deployment and conventional and transgenic breeding methods used to incorporate improved disease resistance into crop species.

P: Basic Undergraduate Level Genetics Class
Typically offered in Spring only

PP 790 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

PP 795 Advanced Special Topics (1 credit hours)
Critical study of special problems and selected topics of current interest in plant pathology and related fields.

PP 801 Seminar In Plant Pathology (1 credit hours)
Discussion of assigned phytopathological topics.

Typically offered in Fall and Spring

PP 810 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall, Spring, and Summer

PP 815 Advanced Special Topics (1-6 credit hours)
Critical study of special problems and selected topics of current interest in plant pathology and related fields.

Typically offered in Fall and Spring

PP 820 Special Problems In Plant Pathology (1-6 credit hours)
Investigation of special problems in plant pathology not related to thesis problem. Investigations may consist of original research and/or literature survey.

Typically offered in Fall and Spring

PP 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

PP 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Spring only

PP 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

PP 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall and Spring

PP 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PP 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Spring only

Political Science (PS)

PS 101 Internet Research (1 credit hours)
Tools and techniques for conducting Internet research and electronic literature reviews. Documentation and ethics of using and citing information sources. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PS 102 Data Analysis (1 credit hours)
Statistical analysis of governmental and survey data. Introduction to data sets and collecting, computerizing and analyzing political and social data.

Typically offered in Fall, Spring, and Summer

PS 103 Designing Political Web Pages (1 credit hours)
Principles of effective internet communication in political professions, for constituency contact and grassroots mobilization, and use of web documents by politicians and political organizations. Design of web page documents and creation of internet directories.

Typically offered in Fall, Spring, and Summer

PS 201 American Politics and Government (3 credit hours)
Analysis of American political institutions and processes, including the constitution, political culture, campaigns and elections, political parties, interest groups, the media, the president, congress, the federal courts, and public policy. Discussion of contemporary and controversial issues in American politics. Emphasis on placing current issues in comparative and historical perspective where relevant.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 202 State and Local Government (3 credit hours)
State and local governments within the context of the American federal system. Special emphasis on federalism, the constitutional/legal relationships between state and local governments, and the institutions, organizational forms, and political processes in American state and local government.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 203/PA 203 Introduction to Nonprofits (3 credit hours)
Development of nonprofit organizations and the contributions of nonprofits in the U.S., other countries, and the international community; political, social, and economic roles of nonprofits; nonprofit governance; partnerships with government and other nonprofits; types of organizations in the nonprofit sector; contemporary policy issues. Service project with minor transportation costs.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 204 Problems of American Democracy (3 credit hours)
Political problems in America from the perspective of political theory. Democracy, economics and politics, racial and sexual equality, civil disobedience, and individual freedom.

Typically offered in Spring only

PS 231 Introduction to International Relations (3 credit hours)
Evolution of relations among nations and of the roles of the United Nations and other international institutions, including changes in the world political system since the end of the cold war.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 236 Issues in Global Politics (3 credit hours)
Selected problems facing the world community, related political issues, and international responses to them, including international trade, economic development, wars, arms control, terrorism, ethnic conflict, human rights, status of women, population growth, food security, and environmental degradation.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 241 Introduction to Comparative Politics (3 credit hours)
Introductory comparative analysis of a selected variety of political systems always including some developed democracies, some communist states and some developing countries. A minimum familiarity with the American political system is assumed.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 298 Special Topics in Political Science (1-6 credit hours)
Experimental course at the freshman and sophomore levels.

PS 301 The Presidency and Congress (3 credit hours)
Historical development, selection, and internal organization of the presidency and congress. Discussion of the relations between the branches and the influence of public opinion, interest groups and parties on the federal government. Analysis of the legislative process.

Prerequisite: PS 201
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 302 Campaigns and Elections in the US Political System (3 credit hours)
Campaigns and elections in the United States with emphasis on presidential and congressional primary and general elections. Development of theoretical propositions concerning how and why people vote, how and why candidates campaign, and behavioral reasons underlying candidates' successes and failures. Special emphasis on the role of the mass media in the electoral process.

Prerequisite: PS 201
GEP Social Sciences
Typically offered in Fall only

PS 303 Race in U.S. Politics (3 credit hours)
Race in American politics with emphasis on the African-American political experience: civil rights legislation, voting rights, political representation, campaigns and party politics, survey attitudes, and public policies including affirmative action.

Requisite: Sophomore Standing or Above
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Summer

PS 305 The Justice System in the American Political Process (3 credit hours)
Criminal justice process and civil justice system in the American judiciary, including court organization and legal professionals such as police, attorneys and judges; formulation and implementation of policies by law enforcement and the courts; impact of political system upon police, attorneys and judges; interaction between public and legal professionals in judicial decision making. Students who have successfully completed PS 306 or PS 311 may not receive credit for PS 305.

GEP Social Sciences
Typically offered in Fall only

PS 306/WGS 306 Gender and Politics in the United States (3 credit hours)
This course explores the role of gender in contemporary American politics. The course examines the historical course of gender politics to see how we have arrived at the present state. It investigates the activities that women and men play in modern politics-voting, running for office, serving in office, etc., and how women and men perform these activities in different ways. The course also focuses on major areas of public policy that affect women and men in different ways.

Prerequisite: PS 201
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

PS 307 Introduction to Criminal Law in the United States (3 credit hours)
Principles underlying the criminal law in the United States and classification of crimes, criminal act, factors affecting criminal responsibility and various types of offenses. Observation of state and federal court sessions.

Typically offered in Fall and Spring

PS 308 Supreme Court and Public Policy (3 credit hours)
The role of the Supreme Court in American politics, with emphasis on the use of litigation as a form of political activity. Readings include relevant court cases as well as descriptions of the Supreme Court in action.

Typically offered in Fall and Spring

PS 309 Equality and Justice in United States Law (3 credit hours)
Equality and justice in American law; federal and state court interpretation of constitutional and statutory law. Topics include racial justice; prisoners' rights and just punishments; nontraditional families and reproductive technologies; gay rights; immigration law; criminal justice practices.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

PS 310 Public Policy (3 credit hours)
Introduction to public policy formulation and analysis, including agenda-setting strategies, problems of legitimation, the appropriations process, implementation, evaluation, resolution, and termination.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 312/PA 312 Introduction to Public Administration (3 credit hours)
Administration in city, state and national governments: effectiveness and responsiveness, involvement in policy areas, and issues of ethics and responsibilities.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PS 313 Criminal Justice Policy (3 credit hours)
This course covers the basic policies and controversies in criminal justice in the United States. The course will explore how criminal justice policies get made, why they get made, how well or poorly they work, and what we can do better. The course will examine primarily longstanding areas of policy debate, e.g., illegal drugs, prisons, capital punishments, etc., but we will also pay attention to policy debates in the news. The course will also pay special attention to the intersection of race and social class with our modern criminal justice policies.

Prerequisite: PS 201
GEP U.S. Diversity
Typically offered in Fall only

PS 314 Science, Technology and Public Policy (3 credit hours)
Technological innovation and scientific discovery since World War II have led to profound social, political, and economic change. This course explores some of the opportunities and challenges these advances have created and the ways in which society and government seek to limit their negative effects while maximizing gains and promoting further innovation.

GEP Social Sciences
Typically offered in Fall only

PS 320 U.S. Environmental Law and Politics (3 credit hours)
Emergence of the environment as an issue in United States politics. Law and policy pertaining to air and water pollution, land-use, water, energy, toxic substances, and wilderness. Roles of national and state governments, scientists, corporations, and citizens groups in addressing environmental problems

GEP Social Sciences
Typically offered in Fall and Spring

PS 331 U.S. Foreign Policy (3 credit hours)
The content, formulation, and execution of U.S. foreign policy during the postwar period, with concentration on major issues and trends, the instruments for implementing foreign policy, and analysis of the policy-making process.

GEP Social Sciences
Typically offered in Fall and Summer

PS 335 International Law (3 credit hours)
Usefulness and limitations of international law, including obligations and immunities of sovereign states, non-state actors, peaceful settlement of disputes, human rights, laws of war, and recent international war crimes tribunals. Emphasis on individual case decisions in U.S. and international courts.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 336 Global Environmental Politics (3 credit hours)
International politics, laws, and policies pertaining to global environmental problems in the realms of population, pollution, climate change, biological diversity, forests oceans, and fisheries.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 339 Politics of the World Economy (3 credit hours)
Politics of international trade and payments, including barriers to trade, dispute settlement, multinational corporations, financial crises, international economic institutions and the problems of economic underdevelopment.

GEP Global Knowledge
Typically offered in Fall only

PS 341 European Politics (3 credit hours)
Comparative analysis of the interests, institutions and processes that determine political stability and economic security in Europe, including the political and economic development of Europe, the role of parties and party politics, the institutions and politics of the European Union.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

PS 342 Politics of China and Japan (3 credit hours)
Politics, public policy, and foreign affairs of China and Japan.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall and Spring

PS 343 Government and Politics in South Asia (3 credit hours)
Survey of government structures, politics, foreign policies and economic policies of India, Pakistan, Bangladesh and Sri Lanka. Democratization; religious, ethnic and sectarian conflicts; nuclear proliferation; Kashmir conflict; and economic development.

Typically offered in Fall only

PS 345 Governments and Politics in the Middle East (3 credit hours)
Historical, geographic, religious, and political-economic factors of the Middle East. Particular attention is given to the internal politics of selected countries, as well as issues of international concern.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Spring only

PS 353 Issues in Latin American and Caribbean Politics (3 credit hours)
Introduction to the major issues affecting political and economic development and stability in Latin America and the Caribbean.

GEP Social Sciences
Typically offered in Spring and Summer

PS 361 Introduction to Political Theory (3 credit hours)
Nature and purpose of politics, as treated by such writers as Plato, Aristotle, St. Augustine, Machiavelli, Locke, Rousseau, Mill, Marx, and Nietzsche.

GEP Humanities
Typically offered in Fall and Spring

PS 362 American Political Thought (3 credit hours)
American ideas and institutions as viewed from the perspective of great American political thinkers, such as Frederick Douglass, Thomas Jefferson, James Madison, Alexander Hamilton, Henry David Thoreau, Abraham Lincoln, Franklin Roosevelt, and Malcolm X.

GEP Humanities
Typically offered in Fall, Spring, and Summer

PS 371 Research Methodology of Political Science (3 credit hours)
Research methods in social science and quantitative analysis in political science and public policy including research design, data collection, statistical analysis and computer applications.

Prerequisite: ST 311 or (ST301 and ST302)
Typically offered in Fall, Spring, and Summer

PS 391 Internship in Political Science (1-6 credit hours)
Internship in a governmental agency, interest group, or like organization involves seminar or formal report. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

PS 398 Special Topics in Political Science (3 credit hours)
For topics not part of regular course offerings, or offering of new courses on a trial basis. May be taken up to three times provided the topics are different.

Typically offered in Fall, Spring, and Summer

PS 401 American Political Parties (3 credit hours)
Political Parties are the central linkage mechanism of American Government. They serve to connect the desires and viewpoints of ordinary Americans to actual governing in Washington and statehouses. The course will explore the structure of the party system in America, how it compares to other countries, and the struggle of third parties in America. The course will also explore political parties as organizations working towards electoral victory. The course will examine parties as changing coalitions of voters and place our current partisan polarization in context. The course will conclude by examining how all these aspects of contemporary political parties come together to shape modern American politics and policy.

Prerequisite: PS 201
Typically offered in Spring only

PS 409/AFS 409 Black Political Participation in America (3 credit hours)
African American political participation in the United States; political culture, socialization, and mobilization, with a focus on the interaction between African Americans and actors, institutions, processes, and policies of the American political system.

Typically offered in Fall only

PS 411 Public Opinion and the Media in American Politics (3 credit hours)
Nature, content, origins, and effects of public opinion in the American political system; role of the mass media in articulating and shaping public opinion; issues concerning measurement of public opinion.

Prerequisite: PS 201
Typically offered in Spring only

PS 415 Administration of Justice (3 credit hours)
Politics and administration in the American system of justice. Credit will not be given for both PS 415 and PA 515

Junior standing or above
Typically offered in Fall and Spring

PS 418/WGS 418 Gender Law and Policies (3 credit hours)
Law and policy pertaining to contemporary gender issues. Examination of agenda setting, policy formation, implementation, judicial interpretation and evaluation of selected issues, such as reproductive policies, equal employment and sexual abuse.

Prerequisite: 3 hours of Political Science
GEP U.S. Diversity
Typically offered in Spring only

PS 431 The United Nations and Global Order (3 credit hours)
United Nations in contemporary world politics. Functions and operation of central organs, commissions, and specialized agencies. Role in addressing global issues including peacekeeping, arms control, human rights, economic and social development, and environment.

Prerequisite: PS 231 or PS 236 or PS 335
GEP Global Knowledge

PS 432/SOC 432 Violence, Terrorism, and Public Policy (3 credit hours)
The course examines interpersonal and group violence in contemporary societies and the causes for its occurrences. Specific forms of violence that will be examined include domestic violence, gangs, homicide, and terrorism, domestically and internationally. Throughout the course students will use data to critically evaluate policies and practices to prevent and control violence and will examine potential solutions to the problems of violence.

Prerequisite: SOC 300 or PS 371
Typically offered in Fall and Spring

PS 433 Global Problems and Policies (3 credit hours)
Critical analysis of issues and events in world politics, including terrorism, drug trafficking and money laundering, transmission of infectious diseases, democratization, globalization and economic development.

Prerequisite: PS 231 or PS 236 or PS 241
GEP Global Knowledge
Typically offered in Fall only

PS 437 U.S. National Security Policy (3 credit hours)
Formulation and implementation of United States national security policy, including its military, political and economic dimensions. Historical evolution of US policy primarily from the end of World War II through the end of the Cold War and to itscontemporary context.

Prerequisite: PS 331

PS 443/PS 543 Seminar in Latin American & Caribbean Politics (3 credit hours)
Comparative political development in Latin America and the Caribbean. Emphasis on democratization and implications for US foreign policy. Credit cannot be given for both PS 443 and PS 543

Prerequisite: Six hours of Political Science including PS 231
Typically offered in Spring only

PS 445/PS 545 Comparative Systems of Law and Justice (3 credit hours)
Legal culture and administration of justice in various countries and in the U.S. Emphasis on the impact of legal ideology on crime, political justice, police administration, corrections and judicial process. Credit will not be given for both PS 445 and PS 545

Junior standing or above
Typically offered in Spring only

PS 462 Seminar in Political Theory (3 credit hours)
A special area in political theory through selected texts, independent research, and seminar reports. Topics vary from year to year, such as ancient and modern political thought, democratic theory, and political theory in literature.

Prerequisite: PS 361 or Consent of Instructor
Typically offered in Spring only

PS 463 Public Choice and Political Institutions (3 credit hours)
Examination of public choice approach to political science. Analysis of political institutions and how they modify human behavior and influence political and policy outcomes. Fulfills department's undergraduate senior seminar requirement.

Prerequisite: Junior standing or Senior standing, Political Science Majors, 12 hours of Political Science Courses
Typically offered in Spring only

PS 464 The Classical Liberal Tradition (3 credit hours)
Analysis of the genesis and development in Europe and North America of liberal ideas such as natural rights, individual liberty, democracy, economic liberalism, religious pluralism, and the rule of law with a particular emphasis on important documents, thinkers, events, and leaders.

Prerequisites: PS 201 or PS 361 or PS 362
Typically offered in Fall only

PS 471 Public Opinion Research Methodology (3 credit hours)
Survey research methodology in public opinion polling, campaign management, media and market research, needs assessment and program evaluation. Topics include questionnaire design, survey sampling, computer applications, and data analysis. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

PS 490 Readings and Research in Political Science (1-6 credit hours)
Extensive readings or research in political science under direct faculty supervision. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

PS 492 Honors Readings and Thesis in Political Science (1-6 credit hours)
Independent reading and preparation of an honors thesis in political science. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Admission to Honors Program
Typically offered in Fall, Spring, and Summer

PS 498 Special Topics in Political Science (1-6 credit hours)
Detailed investigation of a topic. Topic and mode of study determined by the student and a faculty member.

Prerequisite: Six hours of Political Science
Typically offered in Fall and Spring

PS 502 The Legislative Process (3 credit hours)
The formulation of public policy from institutional and behavioral viewpoints. Important current legislative problems at congressional and state legislative levels selected and serve as basis for analyzing legislative process.

Prerequisite: Advanced Undergraduate standing including 12 hrs. of PS, Graduate standing or PBS status
Typically offered in Spring only

PS 506 United States Constitutional Law (3 credit hours)
Basic constitutional doctrines, including fundamental law, judicial review, individual rights and political privileges and national and state power. Special attention given to application of these doctrines to regulation of business, agriculture andlabor and to rights safeguarded by First, Fifth and Fourteenth Amendments to the Constitution.

Prerequisite: 12 hours of PS or Graduate standing or PBS status
Typically offered in Fall only

PS 507 Civil Liberties In the United States (3 credit hours)
Leading constitutional cases in civil liberties and individual rights along with writings of leading commentators.

Prerequisite: 12 hours of PS or Graduate standing or PBS status
Typically offered in Fall and Spring

PS 530 Seminar In International Relations (3 credit hours)
May be taken for up to six hours credit. In-depth examination of a topic within larger field of international politics to be selected by instructor for each semester from subjects pertaining to interstate relations, international law and organization, regional politics, foreign and security policy or global issues. Students undertake substantial independent research project.

Typically offered in Fall only

PS 531 International Law (3 credit hours)
Sources and subjects of international law, domestic and international jurisdictions, judicial settlement, legal and illegal uses of force and substance of law in selected policy areas.

Prerequisite: Graduate standing or Advanced Undergraduate standing
Typically offered in Fall and Spring

PS 532 Seminar in Global Governance (3 credit hours)
The politics of global governance, with emphasis on the role of intergovernmental organizations, non-governmental organizations, international regimes, and supranational institutions, and the comparative analysis of different governance structures. Includes study of the mechanisms of international cooperation between states and their citizens in a variety of issue areas, such as trade, money, development, humanitarianism, the environment, human rights, and security. Graduate standing.

Typically offered in Fall only

PS 533 Global Problems and Policy (3 credit hours)
International policy processes and policy responses to problems of global scope including role of international law. Consideration given to economic development, human rights and other policy problems selected for specific semesters. Independent research on a global policy problem of student's choice.

Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Spring only

PS 534 The Politics of Human Rights Policies (3 credit hours)
Human rights policies and politics within the modern global society; the interplay of international organizations, governments and non-governmental actors in promoting and undermining international human rights; examines how domestic politics, sovereignty, cultural norms, religion, geo-political competition, past colonialism, and economic considerations affect efforts to address human rights violations in different countries; human rights issues such as genocide, humanitarian intervention, women and gender issues, refugees, transitional justice or reconciliation, ethnic/racial divisions, human trafficking, etc. Graduate standing.

Typically offered in Fall only

PS 536 Global Environmental Law and Policy (3 credit hours)
International organizations, laws and policies addressing global environmental problems including: population growth, atmospheric pollution, climate change, use of oceans, forests and biodiversity. Relationship between environment and Third World economic development.

Prerequisite: Graduate standing or PBS status
Typically offered in Summer only

PS 539 International Political Economy (3 credit hours)
Politics of international trade and payments, with special emphasis on international and domestic determinants of protectionism, international and national political institutions, multinational corporations, debt crises, and dilemmas of economic underdevelopment.

Prerequisite: Advanced Undergraduate standing, Graduate standing or PBS status
Typically offered in Fall only

PS 540 Seminar In Comparative Politics (3 credit hours)
This seminar opens with a survey of the problems and methods of comparative political analysis, after which students assigned a specific, limited subject to be examined within framework of a systematic, analytical scheme appropriate to topic. Specific topics drawn from subjects of political ideologies, political groups, political elites and decision-making institutions and processes.

Prerequisite: One course in comparative politics and one course in PS methodology
Typically offered in Fall and Spring

PS 541 Political Islam (3 credit hours)
Explores the diversity of movements, organizations, and political parties that fall within political Islam, from the extremist, violent fringe to democratically functioning groups. Begins with an overview of the interaction of religion and politics before defining political Islam and exploring major groups practicing it. The course provides a comparative perspective on Islam's interactions with the political realm, as well as a study of the role it plays in promoting or hindering democratic development.

Prerequisite: Graduate standing
Typically offered in Spring only

PS 542 European Politics (3 credit hours)
Analysis of political institutions and processes in selected European states and the European community and major social, economic and political issues confronting European societies.

Prerequisite: Nine hours of PS program, Graduate standing or PBS status
Typically offered in Spring only

PS 543/PS 443 Seminar in Latin American & Caribbean Politics (3 credit hours)
Comparative political development in Latin America and the Caribbean. Emphasis on democratization and implications for US foreign policy. Credit cannot be given for both PS 443 and PS 543

Prerequisite: Six hours of Political Science including PS 231
Typically offered in Spring only

PS 544 Contemporary African Politics (3 credit hours)
A survey of key themes, trajectories, and trends in contemporary African politics. It analyzes political and economic development on the continent since the dawn of independence in the late 1950s. Although largely focused on Sub-Saharan Africa, the course will nevertheless touch upon linkages and connections with North Africa as well as diasporic influences and inspirations especially in the pan-African struggles for independence and the forging of new sovereign nation-states.

Prerequisite: Graduate standing
Typically offered in Fall only

PS 545/PS 445 Comparative Systems of Law and Justice (3 credit hours)
Legal culture and administration of justice in various countries and in the U.S. Emphasis on the impact of legal ideology on crime, political justice, police administration, corrections and judicial process. Credit will not be given for both PS 445 and PS 545

Junior standing or above
Typically offered in Fall and Spring

PS 546 The Politics of East Asia (3 credit hours)
This course examines the history and key theoretical and policy debates on the politics of East Asia, which in this course includes China, Japan, two Koreas, and Taiwan. Yet, other countries in and beyond the region (the United States, Russia, Southeast Asian nations) and their relations with the five states are an integral part of the course. The class comprises three parts. Part I introduces the modern history of East Asia. Part II examines the contemporary governments of East Asia, including their political systems and the main debates surrounding their politics. Part III focuses on interstate relations of East Asia and Pacific, comprising a series of topics that are both timely and heatedly debated among intellectuals and policymakers. While these topics are mostly country/countries-specific, they together are important in understanding the regional dynamics of East Asia.

Typically offered in Fall only

PS 547 Russian Politics (3 credit hours)
The course investigates the principal political and societal actors in today's Russia, as well as the key trends in Russia's domestic and foreign policy.

Typically offered in Spring only

PS 560 Nuclear Nonproliferation Policy & Process (3 credit hours)
Policy and processes associated with global nuclear nonproliferation efforts. Special emphasis on the history of the development of the global nonproliferation regime, current challenges, and future threats.

Typically offered in Fall and Spring

PS 561 Nuclear Strategy and Nonproliferation (3 credit hours)
No understanding of world politics is complete without an accounting of the role of nuclear weapons. Observers have credited the nuclear revolution with everything from responsibility for the longest period without a great-power war in modern history to bringing humanity to the precipice of annihilation. This course gives students an understanding of the role that nuclear weapons have played in world politics over the past seven decades. The course explores the ways these weapons have been incorporated into military force structures; the roles they have played in military strategy; and the effort to control their spread, limit deployments and stockpiles, avoid nuclear war, and prevent nuclear terrorism. This course will be of use to graduate students with an interest in international relations, foreign policy, and national security. No prior background in international security or nuclear policy is required.

Typically offered in Fall only

PS 571 Research Methods and Analysis (3 credit hours)
A survey of methods used in behavioral research as applied to field of political science: elements of empirical theory, research design, measurement of variables, sampling procedures, data courses, techniques of data collection, statistical analysis, qualitative methodologies and presentation of research findings.

Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Fall only

PS 585 Constitutional and Legal Principles for Police Supervisors (3 credit hours)
Intensive look at the constitutional underpinnings and restrictions on laws and government agency policies impacting police agencies. Specific constitutional protections relating to interrogation and search of employees, freedom of speech, freedom of religion and drug testing. Legal risks and liabilities facing police managers and how to reduce these risks.

Typically offered in Fall, Spring, and Summer

PS 590 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

PS 598 Special Topics In Political Science (1-6 credit hours)
Detailed investigation of a topic. Topic and mode of study determined by student and a faculty member.

Prerequisite: Six hours of PS program
Typically offered in Fall and Spring

PS 610 Special Topics (1-6 credit hours)
Detailed investigation of a topic. Topic and mode of study determined by student and a faculty member.

Prerequisite: Six hours of PS program
Typically offered in Fall and Spring

Polymer and Color Chemistry (PCC)

PCC 101 Introduction to Polymer and Color Chemistry (2 credit hours)
Introduction of topics related to Polymer and Color Chemistry, e.g. fiber and fiber forming polymers, polymerization methods, into to color assessment methods, various chemistry disciplines, molecular interactions, periodic table, acids, bases, solutions, into to and examples of textile coloration and textile finishing techniques.

Corequisite: PCC 104
Typically offered in Fall only

PCC 104 Introduction to Polymer and Color Chemistry Lab (1 credit hours)
An introduction to hands-on laboratory work for the study of basic polymer principles, dye synthesis, forensic analysis and coloration of fibers.

Corequisite: PCC 101
Typically offered in Fall only

PCC 106 Polymer Chemistry and Environmental Sustainability (3 credit hours)
Polymers are prevalent in almost every part of our lives. Many polymers are petroleum based and their raw material supply is limited. Using a theme of environmental impact, this course will review the origin and preparation of key industrial raw materials and how they are used in polymer synthesis. Properties of synthetic polymers will be introduces and concepts for establishing sustainable polymers will be discussed.

Prerequisite: CH 101 or CH 103; Corequisite: CH 221 or CH 225
Typically offered in Spring only

PCC 201 Impact of Industry on the Environment and Society (3 credit hours)
Relationship of society to safety and environmental aspects of manufactured products. Quantifying manufacturing risks. Protective methods, e.g. administrative, engineering, personal, treatment, pollution prevention. Social factors, e.g. political, regulatory, legal, consumer attitudes, public policy, perceptions. Understanding complex social issues, especially situations with conflicting goals. Critical comparison of options for risk reduction, and selecting reasonable (hopefully optimal) courses of action in complex and uncertain situations. Unsolved problems of industry and society (e.g. greenhouse effect). Relationships of ethics, laws and regulations to manufacturing.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PCC 274 Introduction to Forensic Science (3 credit hours)
The field of forensic science is the application of science to the law. The primary purpose of this course is to introduce students to the 'real world' of forensics. It will serve as a basis for more advanced forensic courses. Solving crimes are often complex and costly affairs, involving myriad science and engineering disciplines, ethics, legal issues, and strong communication skills. These key areas will be introduced via regular course lectures, guest lectures from faculty members within NC State and other institutions, and guest lectures from current or former field agents and professional forensic scientists.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

PCC 301 Technology of Dyeing and Finishing (3 credit hours)
Basic principles and procedures for the preparation, dyeing, printing, and finishing of natural and man-made fibers. The chemical nature of dyes and fastness properties and the chemical nature of finishes used to impart specific end-use properties.

Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 304
Typically offered in Fall and Spring

PCC 302 Technology of Textile Wet Processing (4 credit hours)
Introduction to the science and technology used in textile wet processing. Topics include preparation, dyeing, printing and finishing of textiles, basics of color generation and measurement. Emphasis mainly on cotton, wool, nylon and polyester. Laboratory includes experiments in wet processing and a project on statistical analysis of fabric defects.

Prerequisite: (TT 105 or MT 105 or PCC 101) and (TMS 211 or TE 201) and CH 101 and (PY 211 or (PY 205 and PY 206).
Typically offered in Fall, Spring, and Summer

PCC 304 Technology of Dyeing & Finishing Laboratory (1 credit hours)
Laboratory experience involving the preparation, dyeing, printing, and finishing of natural and man-made fibers.

Prerequisite: PCC 106 or PCC 203 or TE 200 and Corequisite: PCC 301
Typically offered in Fall and Spring

PCC 350 Introduction to Color Science and Its Applications (2 credit hours)
Basic principles and applications of color science. Physical, physiological and psychophysical aspects of color, color perception, color specification, color measurement and color control.

Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 354
Typically offered in Spring only

PCC 354 Intro to Color Science Laboratory (1 credit hours)
An introdiction to hands-on laboratory work for the color measurement and perceotion of colored materials.

Prerequisite: PCC 301 and either PY 208 or PY 212; Corequisite: PCC 350
Typically offered in Spring only

PCC 404 Introduction to the Theory and Practice of Fiber Formation (3 credit hours)
Flow behavior of polymeric materials as related to the formation of fibers by melt, dry and wet extrusion. Elementary theories of drawing and heat setting. Application of fiber-forming theories to synthetic and cellulosic fibers. Offered in Fall only.

Prerequisite: TE 200 and (CH 201 or CH 203) and ((PY 208 and PY 209) or PY 212) and (MA 231 or MA 241)
Typically offered in Fall and Spring

PCC 410 Textile Preparation and Finishing Chemistry (3 credit hours)
Topics in textile wet processing. Chemical mechanisms and unit operations in fabric preparation and finishing.

Prerequisite: PCC 301
Typically offered in Fall only

PCC 412 Textile Chemical Analysis (2 credit hours)
Application of analytical techniques for analysis to fibers, textile chemicals and textile processes; atomic absorption, ultraviolet, visible, near-infrared and infrared spectrophotometer; chromatography; interfacial tension; calorimetric, gravimetric and complexometric analyses. Emphasis on interpretation of data and solving problems of analysis for quantitate and characterization purposes.

Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 414
Typically offered in Spring only

PCC 414 Textile Chemistry Analysis Lab (1 credit hours)
Laboratory course in the application of analytical techniques for analysis of fibers, textile chemicals and textile processes; atomic absorption, ultraviolet, visible, near-infrared and infrared spectrophotometery; chromatography; interfacial tension; calorimetric, gravimetric and complexometric analyses. Emphasis on interpretation of data solving problems of analysis for quantitavive and characterization purposes.

Prerequisite: PCC 301 and (CH 331 or CH 433 or TE 303); Corequisite: PCC 412
Typically offered in Spring only

PCC 420 Textile Dyeing and Printing (3 credit hours)
Topics in coloration of textile fibers; chemical and physical mechanisms in textile dyeing and printing.

Prerequisite: PCC 301
Typically offered in Spring only

PCC 442 Theory of Physico-Chemical Processes in Textiles II (3 credit hours)
Second semester of a two-semester sequence. Ideal and non-ideal solutions, colligative properties. Electro chemistry, dyeing isotherms, chemical kinetics, surface chemistry, theory of repellency and other special topics.

Prerequisite: TE 303 or CH 331 or CH 433
Typically offered in Fall only

PCC 461 Chemistry of Polymeric Materials (3 credit hours)
Polymers are a critical component of most products used by society today. Knowledge of their formation and properties is key to development of the materials of the future. The formation and properties of the major polymers are the primary focus areas of this course, including Step-growth and Chain-growth polymerization, formation techniques for preparation of synthetic fibers and the fundamental relationships between chemical structure and physical properties of natural and synthetic polymers.

Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 464
Typically offered in Fall only

PCC 462 Characterization and Physical Properties of Polymers (3 credit hours)
Properties unique to polymers are related to their high molecular weight, long and flexible chains, or polymers physics. The detailed molecular structures of polymer, pr polymer chemistry, are characterized and utilized to establish structure-property relations. An inside/outside approach connects their microstructures to their local conformational flexibilities, which impact their global responses, such as sizes and shapes and conformational entropies, to both their environments and the stresses placed upon them.

Prerequisite: PCC 461
Typically offered in Spring only

PCC 464 Chemistry of Polymeric Materials Laboratory (1 credit hours)
Polymers are a critical component of most products used by society today. Understanding their formation and properties is key to development of the materials of tomorrow. This laboratory course is focused on preparation of the major synthetic polymers using step-growth and chain-growth polymerization techniques. The properties of the resultant polymers are studied.

Prerequisite: (CH 220 and TE 200) or CH 223 or CH 227; Corequisite: PCC 461
Typically offered in Fall only

PCC 466 Polymer Chemistry Laboratory (3 credit hours)
Synthesis and characterization of polymers; thermodynamics of rubber elasticity and gelation; spectroscopic, thermal and scattering techniques for polymer analysis. The processing of polymers into fibers and films.

Prerequisite: (CH 331 or TE 303 or CH 433) and Senior Standing
Typically offered in Spring only

PCC 471/MT 471 The Chemistry of Synthetic and Natural Bipolymers (3 credit hours)
Introduction to natural and synthetic biopolymers used for biomedical applications. Goals and challenges of biomaterials selection for biomedical engineering. Polymer concepts of polymerization and characterization. Sources/synthesis, chemical and physical properties and degradation mechanisms are described. Polymer classes include: polysaccharides, proteins, polyesters, polyurethanes, polyanhydrides and polyethers.

Prerequisite: CH 220 or 221 or 225
Typically offered in Spring only

PCC 474 Forensic Chemistry Laboratory (3 credit hours)
Forensic chemistry is the application of chemistry to the law. It is a key part of crime scene investigations. In this course, students work in teams and discover standard methods of crime scene processing, latent evidence processing and analysis of materials and chemicals germane to forensic trace evidence. Advanced analytical chemistry techniques will be learned and applied to solve a 'crime' with suspects. Students will attempt to solve the crime and will present their analytical evidence in a courtroom setting with cross-examination.

Prerequisite: (CH 220 or CH 223 or CH 227) and TMS 211
Typically offered in Fall only

PCC 490 Undergraduate Research in Polymer and Color Chemistry (1-6 credit hours)
Faculty-supervised individual research for undergraduates in PCC. Students must find an advisor from within the department with whom to work on a regular basis. Intended for PCC majors. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PCC 301 and PCC 461/CH 461 and (TE 303 or CH 331 or CH 433).
Typically offered in Fall and Spring

PCC 491 Seminar in Polymer and Color Chemistry (1 credit hours)
Familiarizes student with the principal sources of polymer and color chemistry literature and emphasizes importance of keeping abreat of developments in the field. Emphasizes fundamentals of technical writing. Arranged. Intended for PCC majors3

Prerequisite: Senior standing
Typically offered in Fall, Spring, and Summer

PCC 492 Special Topics in Polymer and Color Chemistry (3 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.

Typically offered in Fall, Spring, and Summer

Poultry Science (PO)

PO 150 Poultry Management (3 credit hours)
Principles and practices of commercial market turkey, broiler, and roaster managment. Includes breeding, nutrition, housing, related production parameters, and an examination of contracts and grower-company relationships.

Requisite: Agricultural Institute Only
Typically offered in Spring only

PO 162/VMP 162 Livestock and Poultry Disease Management (3 credit hours)
Basic principles of disease and disease management in livestock and poultry. Disease prevention through sanitation and vaccination. Diseases of horses, pigs, ruminants, poultry, and disease prevention programs for each species

Requisite: Agricultural Institute Only
Typically offered in Spring only

PO 201/PO 201A Poultry Science and Production (3 credit hours)
Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing.

Co-requisite: PO 202
GEP Natural Sciences
Typically offered in Fall and Spring

PO 201A/PO 201 Poultry Science and Production (3 credit hours)
Fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing.

Co-requisite: PO 202
GEP Natural Sciences
Typically offered in Fall and Spring

PO 202/PO 202A Poultry Science and Production Laboratory (1 credit hours)
This laboratory course will cover the fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing. This course includes field trips for which transportation will be provided.

Corequisite: PO 201
GEP Natural Sciences
Typically offered in Fall and Spring

PO 202A/PO 202 Poultry Science and Production Laboratory (1 credit hours)
This laboratory course will cover the fundamental principles of broiler, turkey and egg production including poultry physiology, breeding, incubation, housing, nutrition, disease control, management and marketing. This course includes field trips for which transportation will be provided.

Corequisite: PO 201
GEP Natural Sciences
Typically offered in Fall and Spring

PO 212 Poultry and People: Why did the chicken cross the world? (3 credit hours)
Poultry species play a vital role in modern society. This course engages students to develop research skills including information literacy, data collection, and developing arguments based on evidence. Specific course topics are developed by students during each course offering. General course content will include, but is not limited by the following topics: History of Domestication, Religious Symbolism, Social and Culinary Practice, and Modern Poultry Production (post-1950) commercial and hobby. Delivery of this course will be inquiry based and focus on utilizing research techniques to gather information, develop a hypothesis, collect information, interpret the results, and report findings in multiple formats.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

PO 215 Applied Avian and Aquaculture Nutrition (3 credit hours)
Comparison of poultry and aquaculture digestive systems, nutrient requirements, formulation and nutritional management, influence of growth and production curves, consumption patterns, and feeding management in commercial poultry and aquaculture industries. Feed manufacturing and government regulations.

Prerequisite: CH 101 and CH 102
Typically offered in Spring only

PO 290 Poultry Seminar (1 credit hours)
Exploration of topics related with current and future potential to influence the poultry industry. Guest lectures from industry representatives will include: vertically integrated poultry production, primary breeders, marketing, animal health, veterinary medicine as it relates to poultry, allied equipment manufacturers, and management of poultry companies. Special emphasis on summer internships and career services.

Prerequisite: Sophomore standing
Typically offered in Fall only

PO 322/ANS 322/FS 322 Muscle Foods and Eggs (3 credit hours)
Processing and preserving fresh poultry, red meats, seafood, and eggs. Ante- and post-mortem events as they affect quality, yield, and compositional characteristics of muscle foods. Principles and procedures involved in the production of processedmeat items.

Prerequisite: ZO 160, BIO 181 or BIO 183
Typically offered in Fall only

PO 340 Live Poultry and Poultry Product Evaluation, Grading, and Inspection (3 credit hours)
To provide students with experience handling live poultry as well as working with an learning about USDA grades and evaluation of poultry meat, meat products, and eggs. Develop an understanding of product specifications.

Prerequisite: PO 201
Typically offered in Fall only

PO 404/PO 504 Avian Anatomy and Physiology (4 credit hours)
Principles of avian physiology integrating physiological functions and anatomical structures of organs and organ systems. Practical problems associated with poultry production. The importance of maximizing growth and productivity via exploitation of environmental influences on physiological systems. Credit not given for PO 404 and 504.

Prerequisite: PO 201
Typically offered in Fall only

PO 406/PO 506 Physiological Aspects of Poultry Management (3 credit hours)
Application of physiological principles to modern poultry management and research. Poultry physiology will be related to practical and research management topics including nutrition, housing, ventilation, disease, heat stress, and lighting programs. Students cannot receive credit for both PO 406 and PO 506.

Prerequisite: PO 201, Corequisite: PO 407
Typically offered in Fall only

PO 407 Physiological Aspects of Poultry Management Laboratory (1 credit hours)
Practical experience with poultry husbandry, animal environment management, and feeding in a research environment Laboratory exercises include feeding and nutrition programs, weighing birds, lighting management and infrastructure, biosecurity and sanitation, vaccinations, hatching egg management, brooding, ventilation programs and infrastructure, housing design and infrastructure, SOP development, human safety and health training, and animal care training. Laboratory exercises will prepare students for both commercial poultry industry and animal research management careers. Co-requisite with PO 406. Personal transportation to Chicken Educational Unit required.

Prerequisite: PO 201, Corequisite: PO 406
Typically offered in Fall only

PO 410 Production and Management of Game Birds in Confinement (3 credit hours)
Management principles associated with the successful propagation and rearing of game birds, ornamental birds and waterfowl in confinement. Housing and pen requirements, nutrition, disease control and regulatory issues included.

PO 411 Agrosecurity (3 credit hours)
This course is designed to increase the awareness of the issues and vulnerabilities of the IS agricultural system, the importance of agriculture in the US economy, and the importance of protecting it from disease and/or attack. This course is organized to integrate and assimilate knowledge across multiple disciplines including agriculture, animal health, human health, infectious diseases, business, economics, and public policy. Students will identify and analyze the interactions between these disciplines in light of increasing population and concentrated agriculture's increased vulnerability to major disruptions in food production. Students will also analyze where potential links in the food chain are susceptible to disruptions by individuals (or natural disasters), the consequences of these disruptions, and how to minimize the associated risks by developing case studies and strategies for defending against specific threats. Students must have junior standing.

Junior standing or above
GEP Interdisciplinary Perspectives
Typically offered in Spring only

PO 412 Emerging Topics in Poultry Science (3 credit hours)
This course is designed to allow students to merge science taught in previous Poultry Science courses with topics considered of interest or emerging in the poultry industry. Students will utilize science and critical thinking skills to solve real world scenarios. This course is designed for students that have completed PO 201 and PO 202. Junior or Senior standing.

Typically offered in Spring only

PO 415/PO 515/NTR 515/ANS 515/ANS 415/NTR 415 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

PO 421 Commercial Egg Production (3 credit hours)
Principles and current practices of commercial egg production. The Commercial Egg Industry as it is currently evolving and operating in the US. We will examine the development of the industry as it has progressed through integration, consolidation, and expansion. We will also look at the outside influences on the industry such as federal government, European Economic Community (EEC) perspective, animal welfare and consumer desire for naturally raised poultry and poultry products.

Prerequisite: PO 201
Typically offered in Spring only

PO 424 Poultry Meat Production (3 credit hours)
Principles and current practices of vertically integrated broiler and turkey production; encompassing management, nutrition, poultry health, environmental, and related areas.

Prerequisite: PO 201
Typically offered in Spring only

PO 425/NTR 525/FM 525/ANS 525/PO 525/NTR 425/ANS 425/FM 425 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall and Spring

PO 426/FM 426 Feed Manufacturing Technology Laboratory (1 credit hours)
Laboratory associated with feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture. PO/ANS/FM 425 is a required course for the Poultry Science Technology Concentration (TPS); the Feed Milling Minor (FEM); and the Feed Mill Certificate.

Corequisite: PO 425 or ANS 425 or FM 425 and FEM minor or 11PLTRYBS
Typically offered in Spring only

PO 433/PO 533 Poultry Processing and Products (3 credit hours)
Poultry processing, further processing, and resulting products as affected by basic muscle composition and function during the conversation of muscle to meat. Microbiology of spoilage and pathogenic organisms, and the regulatory and HACCP programs designed to minimize problems. Overall business functions of poultry processing to understand profit/loss factors, and skills necessary for communication and management. Various sections on sanitary design/construction, pest control, wastewater treatment, and further processed egg products. Credit for both PO 533 and PO 433 is not allowed. Transportation to field trips will be provided. Non-scheduled class time for field trips or out-of-class activities may be required for this class. Transportation to scheduled labs at Lake Wheeler CEU/Poultry Processing Lab will be provided by students.

Prerequisite: PO 201
Typically offered in Fall only

PO 435 Poultry Incubation & Breeding (4 credit hours)
Principles and current practices of modern poultry incubation and breeding production systems. Students will be able to describe basic elements of breeding management and production practices, to apply those elements to specific scenarios, and to strengthen their ability to interpret and make critical judgements relative to the breeding of poultry, production of hatching eggs, and the subsequent incubation and hatching process.

Prerequisite: PO 201
Typically offered in Spring only

PO 492 External Learning Experience (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PO 493 Special Problems in Poultry Science (1-6 credit hours)
A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

PO 495 Special Topics in Poultry Science (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for offering of new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PO 504/PO 404 Avian Anatomy and Physiology (4 credit hours)
Principles of avian physiology integrating physiological functions and anatomical structures of organs and organ systems. Practical problems associated with poultry production. The importance of maximizing growth and productivity via exploitation of environmental influences on physiological systems. Credit not given for PO 404 and 504.

Prerequisite: PO 201
Typically offered in Fall only

PO 506/PO 406 Physiological Aspects of Poultry Management (3 credit hours)
Application of physiological principles to modern poultry management and research. Poultry physiology will be related to practical and research management topics including nutrition, housing, ventilation, disease, heat stress, and lighting programs. Students cannot receive credit for both PO 406 and PO 506.

Prerequisite: PO 201, Corequisite: PO 407
Typically offered in Fall only

PO 510 Poultry Product Safety: An On-Farm Model (3 credit hours)
Typically offered in Spring only

PO 515/NTR 515/ANS 515/ANS 415/NTR 415/PO 415 Comparative Nutrition (3 credit hours)
Principles of nutrition, including the classification of nutrients and the nutrient requirements of and metabolism by different species for health, growth, maintenance and productive functions.

Prerequisite: ANS 225 or ANS 230 or CH 220 or CH 223 or CH 227
Typically offered in Fall, Spring, and Summer

PO 524/ZO 524/PHY 524 Comparative Endocrinology (3 credit hours)
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

Prerequisite: BIO 421 or PO 405
Typically offered in Spring only

PO 525/NTR 425/ANS 425/FM 425/PO 425/NTR 525/FM 525/ANS 525 Feed Manufacturing Technology (3 credit hours)
Feed mill management, feed ingredient purchasing, inventory, storage, and quality evaluation, computerized feed formulation, feeding programs for poultry and swine, feed mill design, equipment, maintenance, operation, safety, state and federal regulations pertaining to feed manufacture.

Prerequisite: ANS(NTR,PO) 415 or ANS 230 or ANS 225
Typically offered in Fall, Spring, and Summer

PO 533/PO 433 Poultry Processing and Products (3 credit hours)
Poultry processing, further processing, and resulting products as affected by basic muscle composition and function during the conversation of muscle to meat. Microbiology of spoilage and pathogenic organisms, and the regulatory and HACCP programs designed to minimize problems. Overall business functions of poultry processing to understand profit/loss factors, and skills necessary for communication and management. Various sections on sanitary design/construction, pest control, wastewater treatment, and further processed egg products. Credit for both PO 533 and PO 433 is not allowed. Transportation to field trips will be provided. Non-scheduled class time for field trips or out-of-class activities may be required for this class. Transportation to scheduled labs at Lake Wheeler CEU/Poultry Processing Lab will be provided by students.

Prerequisite: PO 201
Typically offered in Fall only

PO 580/FM 580 Feed and Ingrdient Quality Assurance (3 credit hours)
The course will teach students the principles of feed and ingredient quality assurance and how to develop a comprehensive quality assurance program. The course will include the development of an approved supplier list, ingredient specifications, feed manufacturing quality assurance procedures, and risk based feed safety programs.

Prerequisite: NTR(FM) 525
Typically offered in Fall only

PO 590 Special Problems in Poultry Science (1-6 credit hours)
.

Typically offered in Fall, Spring, and Summer

PO 601 Seminar (1 credit hours)
Preparation for research, research perspectives, rising concerns in poultry production, orientation for graduate studies in poultry science. Required of all graduate students in the Department of Poultry Science.

Typically offered in Spring only

PO 620 Special Problems (1-6 credit hours)
Specific problems of study assigned in various phases of poultry science.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PO 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PO 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

PO 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

PO 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring and Summer

PO 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

PO 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PO 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PO 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PO 757/IMM 757 Comparative Immunology (3 credit hours)
Compare and contrast the immune system structure and function of animal species of agricultural and veterinary significance with that of humans and traditional biomedical model organisms. Discuss key evolutionary differences, how different species use different mechanisms to achieve the same outcomes, and the clinical implications for these differences.

Prerequisite: MB 751 or MB 441 or BIO 414
Typically offered in Spring only

PO 775/NTR 775 Mineral Metabolism (3 credit hours)
Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated withmineral functions and the metabolic bases for the development of signs of deficiency.

Prerequisite: ANS(NTR,PO) 415, BCH 451 and ZO 421
Typically offered in Fall only

PO 801 Graduate Seminar In Poultry Science (1 credit hours)
Preparation for research, research perspectives, rising concerns in poultry production, orientation for graduate studies in poultry science. Required of all graduate students in the Department of Poultry Science.

Typically offered in Spring only

PO 820 Special Problems In Poultry Science (1-6 credit hours)
Specific problems of study assigned in various phases of poultry science.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PO 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planing for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

PO 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Spring only

PO 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Spring only

PO 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PO 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PO 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Professional Writing (WRT)

WRT 111 Expository Writing (3 credit hours)
Emphasis on writing process including audience analysis, topic selection, thesis support and development, editing and revision. Upon completion, students should be able to prepare unified, coherent, well-developed essays using standard written English. AGI majors only. C-Wall course; prerequisite for WRT 114, professional Writing, Research and Reporting.

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

WRT 114 Professional Writing, Research and Reporting (3 credit hours)
Emphasis placed on research, listening, critical thinking, analysis, interpretation and design used in oral and written presentations. Upon completion, students should be able to work individually and collaboratively to produce well-designed and professionally written and oral presentations. Restricted to AGI majors; C-Wall course.

Prerequisite: WRT 111
Typically offered in Fall and Spring

Psychology (PSY)

PSY 200 Introduction to Psychology (3 credit hours)
Survey of basic principles for the understanding of behavior and experience including development, learning, cognition, biological foundations, perception, motivation, personality, behavior abnormalities, measurement of individual differences, and social processes. The value of scientific observation and experimentation to the development of psychological understanding is emphasized.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 208 Psychobiology of Success (3 credit hours)
Exploration of what happens within your body when you experience stress, techniques to alter your body's response, ways to manage your thoughts and emotions to enhance your performance. Development of an understanding of why your physiology and your background do not have to determine your future. Across all topics, students will critically examine biological, psychological, and medical evidence regarding stress responses, stress management and optimizing functioning.

GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Summer only

PSY 230 Introduction to Psychological Research (3 credit hours)
This course is an introduction to the principles of scientific research. Students will develop and test research hypotheses in accordance with methods approved by the American Psychological Association. Methods of analyzing data and the interpretation of research findings will be stressed. Students will work in teams to collect, analyze, report, and provide a professional presentation of a group research project. Psychology majors and minors must take the course under the graded option.

Prerequisite: PSY 200
Typically offered in Fall, Spring, and Summer

PSY 240 Introduction to Behavioral Research I (3 credit hours)
Introduction to quantitative methods in psychology, including measurement, experimental control, validity, and fundamentals of research design. Discussion of distributions and statistical inference. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 241
Typically offered in Fall and Spring

PSY 241 Introduction to Behavioral Research I Lab (1 credit hours)
Students design, analyze and report a variety of simple experiments. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY 200, Corequisite: PSY (ST) 240
Typically offered in Fall and Spring

PSY 242 Introduction to Behavioral Research II (3 credit hours)
Continuation of PSY (ST) 240. Ethics of Research in Psychology. Techniques for the development of research proposals. Statistical techniques for data analysis including non-parametrics, one-way and two-way ANOVA and introduction to correlation and regression. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 243
Typically offered in Fall and Spring

PSY 243 Introduction to Behavioral Research II Lab (2 credit hours)
Design and analysis of a major research project. Individualized/ Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: PSY or HRD Majors, PSY (ST) 240, Corequisite: PSY (ST) 242
Typically offered in Fall and Spring

PSY 307 Industrial and Organizational Psychology (3 credit hours)
Surveys the application of psychological theories and methods to problems involving people in working settings. Topics include: organizational and management theory; work motivation and job satisfaction; job and organizational analysis; performance evaluation; personnel recruitment, selection, and placement; and personnel training and development.

Prerequisite: PSY 200 or PSY 201
Typically offered in Fall, Spring, and Summer

PSY 311 Social Psychology (3 credit hours)
Theory and research on how individuals respond and are responded to in social situations. Topics include attitude formation and change, affiliation, attraction, self and interpersonal perception, interpersonal relationships, aggression, helping behavior, intergroup behavior, and group dynamics.

Prerequisite: PSY 200 or PSY 201
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 312 Applied Psychology (3 credit hours)
Covers diverse areas of psychological practice, related methods and ethical issues. Includes illustrative cases of psychological practice in health, education, work settings, law, sports, consumer markets, and cross-cultural settings. Explores professional roles and contributions in the contexts of social, organizational and technological change.

Prerequisite: PSY 200 or PSY 201
Typically offered in Fall and Spring

PSY 313 Positive Psychology (3 credit hours)
Positive psychology is the scientific study of positive experience, positive individual traits, and the institutions and practices that facilitate their development. This course reviews the history of positive psychology and the contributions this new field has made to several traditional research areas in psychology. Among other issues, the course will address the questions such as: What is happiness and how should we measure it? What determines subjective well-being? Can (and should) we deliberately increase happiness? (Restricted to psychology majors)

Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 340 Human Factors Psychology (3 credit hours)
This course covers the fundamental principles of Human Factors Psychology - the science and practice of understanding the fit between people and the systems with which they interact - by focusing on improving efficiency, creativity, productivity, and safety. The course provides an overview of fundamental topics, such as perception, attention, memory, decision making, and motor control, as well as specific domains within the field, such as information technology, healthcare, aging, and transportation with an emphasize on the methods used for research and design in Human Factors.

P: PSY 200
Typically offered in Fall and Spring

PSY 345/AFS 345 Psychology and the African American Experience (3 credit hours)
Historical and cultural examination of the psychological experiences of African American experience from pre-American times to the present. Focus on mental health, personality, identity development, racism, oppression, psychological empowerment andan African-centered world view. Discussion of contemporary issues within the African American community.

Prerequisite: PSY 200 or PSY 201
GEP U.S. Diversity
Typically offered in Fall and Spring

PSY 360 Community Psychology Principles and Practice (3 credit hours)
This course provides an introduction to the field of community psychology. The aim of this course is to help empower students to contribute to effective social change in their communities. Community psychology focuses upon person-environment interactions and the ways individuals navigate between different social contexts (e.g. schools, neighborhood, community, and society). Community psychologists employ a variety of methodological approaches to understand the social issues facing communities today such as juvenile violence, homelessness, HIV-AIDS, and domestic violence.

Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 370 Personality (3 credit hours)
Major personality theories. Definition of personality associated with each theory as well as the assumptions and principles used in accounting for human behavior. Theories evaluated considering recent research.

Prerequisite: PSY 200
Typically offered in Fall, Spring, and Summer

PSY 376 Developmental Psychology (3 credit hours)
Behavioral development during the life span, including study of current theories and project work with persons at various stages of the life cycle.

Prerequisite: PSY 200 or EDP 304
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PSY 400 Perception (3 credit hours)
Anatomy and physiology of the major sensory systems, their relationship to central structures of the brain, important and/or common pathological conditions. Basic issues and techniques of psychophysics. Perceptual phenomena and theory, with an emphasis on topics in two-and three-dimensional spatial perception, including the perceptions of size, depth and motion. Consideration of perceptual phenomena in practical settings.

Prerequisite: PSY 200 or PSY 201, Junior/Senior
Typically offered in Fall and Spring

PSY 406/WGS 406 Psychology of Gender (3 credit hours)
This course is designed to introduce students to the origins and significance of the study of gender differences and gender relations from a psychological perspective. The course focuses on current theory and research on perceived and actual biological, social, cognitive, personality and emotional similarities and differences of men and women throughout the lifespan as well as the construction and meaning of gender in our society.

Prerequisite: PSY 200 or WGS 200
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

PSY 410 Learning and Motivation (3 credit hours)
Introduction to the primary laboratory research areas in learning and motivation: classical conditioning, operant conditioning, verbal learning, drive theory, and the role of motives. Emphasis upon research on conditioning and its motivational processes as the foundations for techniques in behavior modification. Examination of both the uses and limitations of current information on learning and motivation.

Prerequisite: PSY 200, Junior standing
Typically offered in Fall and Spring

PSY 411 The Psychology of Interdependence and Race (3 credit hours)
The Psychology of Interdependence and Race is designed to explore how interpersonal relationships are structured and how two-person interactions within those structures are influenced by race. Drawing on the major social psychological theory of interpersonal relationships - Interdependence Theory - this course will provide students with an understanding of the various structures of interpersonal relationships in order to explore how and why the presence of race (and other diversity categories) influence the ways in which people try to interact with each other within those interpersonal structures.

Prerequisite:PSY 311
Typically offered in Fall and Spring

PSY 416 Psychology of Emotion (3 credit hours)
Introduction to the classic and contemporary theories of emotion, with strong emphasis on how data provide evidence to test theory. Biological, cognitive, social, and cultural foundations are explored.

Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 420 Cognitive Processes (3 credit hours)
Introduction to research and theory in cognition, including such topics as memory, acquisition and use of language, reading, problem-solving, reasoning, and concepts.

Prerequisite: PSY 200, Junior standing
Typically offered in Fall, Spring, and Summer

PSY 425/PHI 425 Introduction to Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.

Prerequisite: One upper-level PHI, PSY, CSC or Linguistics course. Credit is not allowed for PHI 425 and PHI/PSY 525.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

PSY 430 Biological Psychology (3 credit hours)
Biological mechanisms of behavior, including elementary neuroanatomy and neurophysiology, sensory and motor processes, and their application to motivation, learning, and psychological processes.

Prerequisite: PSY 200 and (BIO 105/106 or BIO 181)
Typically offered in Fall, Spring, and Summer

PSY 431 Health Psychology (3 credit hours)
Introduction to health psychology. This course provides an overview of the field of health psychology, which is concerned with how behavior and psychological states influence physical health (i.e., how people stay healthy, why people become ill, and how people respond to illness). Application of psychological theory and research methods to such topics as: pain, stress and coping, helplessness and control, reactivity to stress, the effectiveness of behavioral interventions in health, illness prevention, health maintenance, recovery from injury and chronic pain, adjustment to chronic illness, treatment compliance.

Prerequisite: PSY 200 and (PSY 230 or PSY 240/242 OR equivalent research methods course).
Typically offered in Fall and Spring

PSY 432 Human Sexuality and Intimate Relationships (3 credit hours)
The course will focus on sexuality and intimate relationships from a biopsychosocial approach. We will explore concepts such as the development of gender identity and gender roles, sexual identity, intimacy, and sexuality across the lifespan by applying different psychological, cultural, and biological approaches, as well as discussing different research methods in the area of sexual and relationship science.

Prerequisite: PSY 200
GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall only

PSY 436 Introduction to Psychological Measurement (3 credit hours)
The basic principles of psychological measurement, including elementary statistical concepts, reliability, and validity. Emphasizes measurement in the science of psychology. Application of measurement principles to a wide variety of measurement problems.

Prerequisite: PSY 240-241
Typically offered in Spring only

PSY 465 Advanced Methods in Psychology (3 credit hours)
Provides students with practical experience in psychological research. Emphasis will be on hands-on training in analyzing data to develop practical problem-solving skills important in psychology research as well as in other related careers working with data.

Prerequisite: PSY 230 and ST 311
Typically offered in Fall and Spring

PSY 470 Abnormal Psychology (3 credit hours)
Common psychological disorders of children and adults. Historical and theoretical perspectives on abnormal behavior; issues of assessment and classification, etiology, symptoms, and treatment of disorders.

Prerequisite: PSY 200 or 304 or EDP 304
Typically offered in Fall, Spring, and Summer

PSY 475 Child Psychology (3 credit hours)
Theories, methods, and phenomena of child psychology and application of this information to the enhancement of child development. Multiple aspects of development, including physical, cognitive/intellectual, and social/emotional development, from conception to adolescence. Emphasis on recent research findings in developmental psychology.

Prerequisite: PSY 200 or 304 or EDP 304; PSY 376
Typically offered in Fall and Spring

PSY 476/EDP 476 Psychology of Adolescent Development (3 credit hours)
Theories, principles, and issues of human psychological development emphasizing adolescence. Cognitive, social, and physical changes; their interaction. Implications for teaching and parenting adolescents.

Prerequisite: PSY 200 or EDP 304
Typically offered in Fall, Spring, and Summer

PSY 491/PSY 590 Special Topics in Psychology (3 credit hours)
Exploration in depth of advanced areas and topics of current interest in psychology.

Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 495 Community-Based Applied Psychology (4 credit hours)
Service learning course that covers one or more areas of psychological practice, including relevant research methods, community engagement principles and practices, and ethical issues. Includes learning about psychological practice in at least one of the following settings: health, education, work settings, law, sports, community-based setting, consumer markets, and/or cross-cultural settings. Explores professional roles and contributions in the contexts of social, education, organizational and/or technological change. An internship liability insurance fee is required.

Prerequisite: PSY 200 and PSY 230
Typically offered in Fall and Spring

PSY 498 Psychology Honors Seminar (3 credit hours)
Seminar and independent study under faculty direction. Provides the undergraduate psychology honors students with an opportunity to practice skills in designing, conducting, and evaluating research. The student, working closely with a faculty advisor, designs a research approach to a particular body of literature, accumulates appropriate data, and analyzes and evaluates the data. Must take two semesters

Prerequisite: HRD and PSY honors students
Typically offered in Fall and Spring

PSY 499 Individual Study in Psychology (1-6 credit hours)
Individual research project (literature review, experiment, survey, field study) open to any undergraduate, under the direction of a Psychology Department faculty member.

Corequisite: PSY 495 for HRD majors during their work semester
Typically offered in Fall, Spring, and Summer

PSY 500 Visual Perception (3 credit hours)
Detailed consideration of anatomy and physiology of visual system (both peripheral and central components). Modern quantitative approaches to psychophysical problems of detection, discrimination, scaling. Examination of chief determinants of visual perception, including both stimulus variables and such organismic variables as learning, motivation and attention. Discussion of perceptual theory and processes emphasizes several topics in two- and three-dimensional spatial perception.

Prerequisite: Graduate standing
Typically offered in Fall only

PSY 502 Physiological Psychology (3 credit hours)
Physiological foundations of behavior, basic vertebrate neuroanatomy and neurophysiology.

Prerequisite: Twelve hours of PSY including PSY 200, 400,410
Typically offered in Spring only

PSY 504 Evolutionary Psychology (3 credit hours)
Emphasis upon use of evolutionary theory to understand the interaction of genetic and environmental influences on human behavior and thought. Topics include human mating, kinship, parenting, cooperation, aggression, cognition, and morality.

Typically offered in Fall and Spring

PSY 508 Cognitive Processes (3 credit hours)
Emphasis upon the results from research on a number of complex processes (e.g., remembering, concept learning, problem solving, acquisition and use of language) and the theories that have been proposed to explain these results.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

PSY 510 Advanced Problems In Psychology (1-3 credit hours)
Offers opportunities to explore various areas of psychology. Sections: Section D, developmental psychology; Section X, experimental psychology; Section I, industrial-organizational and vocational psychology; Section S, social psychology.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PSY 511 Advanced Social Psychology (3 credit hours)
A survey of theory and research in social psychology through reading and discussion of primary source materials. In addition, the course deals with issues of methodology, ethical questions in social psychological research and application of researchfindings to the world at large.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

PSY 525/PHI 525 Introduction To Cognitive Science (3 credit hours)
Philosophical foundations and empirical fundamentals of cognitive science, an interdisciplinary approach to human cognition. Topics include: the computational model of mind, mental representation, cognitive architecture, the acquisition and use of language. Students cannot receive credit for both PHI/PSY 425 and PHI/PSY 525.

Prerequisite: Graduate standing. Credit is not allowed for PHI 525 and PHI/PSY 425.
Typically offered in Spring only

PSY 535 Tests and Measurements (3 credit hours)
A study of the principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability and validity. In addition, some attention devoted to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality and interest inventories.

Prerequisite: Six hours of PSY program
Typically offered in Fall and Spring

PSY 540/ISE 540 Human Factors In Systems Design (3 credit hours)
Introduction to problems of the systems development cycle, including human-machine function allocation, military specifications, display-control compatibility, the personnel sub-system concept and maintainability design. Detailed treatment given to people as information processing mechanisms.

Prerequisite: IE 452 or PSY 340, Corequisite: ST 507 or 515
Typically offered in Spring only

PSY 541 Overview of Human Factors Psychology (3 credit hours)
An overview of Human Factors Psychology covering a large number of tools, topics, and exercises important for the field of human factors. Includes topics fundamental to human factors research, such as attention, decision making, and motor control, as well as specific domains within human factors, such as information technology, healthcare, aging, and transportation, with particular emphasis on the methods used for study of these areas. A group project will give students experience with the usability evaluation process.

Typically offered in Fall only

PSY 558 Psychology and the African Experience (3 credit hours)
An ethnographic approach to the psychology of peoples of African descent through examination of the influence of historical and cultural phenomena. Specific attention to understanding the Africentric world view and issues of mental health, personality and identity development, racism, oppression and empowerment.

Prerequisite: Six hours PSY program
Typically offered in Spring only

PSY 582/EDP 582 Adolescent Development (3 credit hours)
Current theories and research on development during adolescence. Topics include: physical growth, cognitive changes, relationships with peers, parents and teachers, quest for identity and independence, morality and sexuality.

Prerequisite: 6 hours in PSY
Typically offered in Spring and Summer

PSY 584 Advanced Developmental Psychology (3 credit hours)
A survey of the role of growth and development in human behavior, particularly during the child and adolescent periods. This course pays particular attention to basic principles and theories in the area of developmental psychology.

Prerequisite: Nine hrs. of PSY, including PSY 376, PSY 475 or PSY 476
Typically offered in Fall only

PSY 590/PSY 491 Special Topics in Psychology (3 credit hours)
Exploration in depth of advanced areas and topics of current interest in psychology.

Prerequisite: PSY 200
Typically offered in Fall and Spring

PSY 591 History and Systems Of Psychology (1-3 credit hours)
Aim of this course is to acquaint students with the history of psychology and psychological systems and to give students some practice in taking different approaches to a particular problem area.

Prerequisite: PSY 200,400,410,420, Consent of Instructor or Graduate standing
Typically offered in Spring only

PSY 641 Psychological Clinic Practicum (1-12 credit hours)
Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children.

Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723.
Typically offered in Fall and Spring

PSY 651 Internship In Psychology (1-6 credit hours)
Supervised work experience in an appropriate setting with professional supervision in the field from a doctoral level psychologist with credentials and/or experience in the appropriate specialty in psychology. Experience consists of full time for one semester or half time for an academic year or equivalent time.

Prerequisite: Approval of advisory committee
Typically offered in Fall and Spring

PSY 680 Directed Study Psychology (1-6 credit hours)
Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student and not to be part of thesis or dissertation research. Credits Arranged

Typically offered in Fall, Spring, and Summer

PSY 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PSY 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PSY 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall and Spring

PSY 704 Learning and Motivation (3 credit hours)
A systematic analysis of some of the major classes of variables determining behavioral change. Learning variables analyzed within their primary experimental setting, and emphasis upon the diversity of the functions governing behavior change rather than upon the development of some comprehensive theory. Examination of both learning and motivational variables as they contribute to changes in performance within the experimental setting.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PSY 705 Affect and Cognition (3 credit hours)
Critical examination of research and theory dealing with the intersection of affect and cognition. Topics will include the impact of emotion, mood and other aspects of affective experience on memory, decision making, judgment, and reasoning. Developmental and individual difference will be explored, as will the neuropsychological underpinnings of observed relationships.

Prerequisite: SIx Hours of Graduate Level PSY
Typically offered in Spring only

PSY 706/WGS 706 Psychology of Gender (3 credit hours)
Current theory and research on perceived and actual biological, social, cognitive, personality, and emotional similarities and differences of men and women throughout lifespan. Construction and consequences of gender in our society and others.

Typically offered in Fall and Spring

PSY 710 Special Topics In Psychology (1-3 credit hours)
Course provides opportunity for exploration in depth of advanced topical areas which, because of their degree of specialization, are not generally involved in other courses; for example, multivariate methodology in psychology, computer simulation, mathematical model building. Some new 700-level courses will first be offered under this title during developmental phase and as such may involve lectures and/or laboratories.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

PSY 714 Social Psychology: Small Groups Research (3 credit hours)
Surveys the literature and research pertaining to social psychological processes in and between groups. Course content includes basic principles of group formation, role differentiation, communication, influence, norms, social exchange, equity, cooperation/conflict, decision making and pro-social behavior. Environmental factors affecting group behavior also considered. In conjunction with each substantive topic, suitable methodologies for research considered.

Prerequisite: PSY 511
Typically offered in Spring only

PSY 721 Area Seminar In School Psychology (1-6 credit hours)
The following topics dealt with: (1) the development of school psychology as a professional area, (2) methods of inquiry, (3) scientific and theoretical bases, (4) contemporary issues, (5) ethical questions, (6) relationship to other areas within psychology.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PSY 722 Individual Intelligence Measurement (4 credit hours)
Theoretical approaches to and individual assessment of intellectual functioning, child development, adaptive behavior, and visual motor functioning. Administration, scoring, and interpretation of current standardized instruments and nonstandardizedassessment. Written communication of findings.

Prerequisite: PSY 535 and consent of school psychology coordinator
Typically offered in Fall only

PSY 723 Personality Measurement (3 credit hours)
Theory and practicum in individual personality testing of children and adults with emphasis on projective techniques, other personality measures, report writing and case studies.

Prerequisite: PSY 722
Typically offered in Spring only

PSY 724 Psychological Intervention I (3 credit hours)
Designed to examine theories, research, techniques, ethics and professional responsibilities related to approaches to psychological intervention. Types of psychological intervention include behavior modification, milieu approaches, crisis intervention techniques and group process methods, in addition to more intensive relationship approaches. A close integration of experiences, content and supervision emphasized in a variety of professional settings with a wide range of personal problems and age groups.

Prerequisite: PSY 723
Typically offered in Fall only

PSY 725 Psychological Intervention II (3 credit hours)
The primary purpose of this course is to provide students opportunities to acquire information, conceptual frameworks, interpersonal skills and a sense of ethical responsibility, all basic to their further development as practicing psychologists. A major effort in the course made to help the student increase his/her interpersonal skills as a means of promoting the psychological growth and effective-ness of others.

Prerequisite: PSY 724
Typically offered in Fall only

PSY 727 Psychological Consultation (3 credit hours)
Introduction to psychological consultation with emphasis on school setting. Presentation of various consultation models and theoretical bases. Development of skills in practice of consultation.

Prerequisite: Nine hrs. grad. PSY or ED
Typically offered in Spring only

PSY 740/ISE 740 Engineering Psychology of Human-computer Interaction (3 credit hours)
Exploration of usability of computer technology. Theory and practice of user-centered design for HCI applications. Course focuses on current usability paradigms and principles, psychology of users, iterative and participatory design processes, system requirements specification, prototyping, user support systems, usability evaluation and engineering, interface design guidelines and standards. Application domains include, universal design, virtual reality, and scientific data visualization.

Prerequisite: IE(PSY) 540 or CSC 554

PSY 743/ISE 743 Ergonomic Performance Assessment (3 credit hours)
Fundamentals of ergonomic performance measurement used to assess the effects of environment and system design on human performance. Treatment of topics such as workload measurement, measurement of complex performance, simulator studies, measurement of change, task taxonomies, criterion task sets and statistical methods of task analysis. Problems of laboratory and field research, measurement of change and generalizability of findings.

Prerequisite: PSY 200, ST 507 and 508
Typically offered in Fall only

PSY 745/ISE 745 Human Performance Modeling (3 credit hours)
Advanced aspects of human performance research. Qualitative models of human information processing. Characteristics and role of memory in decision making and response execution. Sensory channel parameters, attention allocation, time-sharing of tasks. Situation awareness and workload responses in complext tasks. Limitations of human factors experimentation. Factors in human multiple task performance. Cognitive task analysis and computational cognitave modeling/simulation of user behavior in specific applications.

Prerequisite: ST 507 or 515 or equivalent; IE (PSY) 540, CSC 554 or IE (PSY) 744

PSY 750 The Psychology of Inequality (3 credit hours)
The following topics dealt with: (1) inequality and social justice as key areas of inquiry for Applied Social and Community Psychology, (2) methods of inquiry for social change, (3) contemporary issues, (4) ethical questions, (5) relationship to other areas within psychology.

Typically offered in Fall only

PSY 751 Intervention Planning & Evaluation (3 credit hours)
Review of the literature, methods and research issues in the field of program intervention, planning and evaluation. Goal-setting, needs assessment, information systems, subjective probability, human resource accounting, decision processes, incentive programs, human productivity and related subjects. Focus on planning and evaluation methods for communities and organizations.

Prerequisite: Graduate standing or PBS status, Corequisite: ST 507
Typically offered in Spring only

PSY 752 Action Research In Psychology (3 credit hours)
Action research models in psychology and their relationships to research methods. Research in field settings and implications for ethics and social responsibility, internal and external validity, experimenter and volunteer effects and problems of measurement.

Prerequisite: ST 511, Corequisite: ST 508
Typically offered in Spring only

PSY 753 Principles and Practice Of Ecological/Community Psychology (3 credit hours)
Introduction to community psychology and its attempt to redefine social problems according to an ecological frame-of-reference with emphasis on humanitarian values, cultural diversity, the promotion of a psychological sense of community among individuals and groups, and the need for psychologists to engage in systematic community research and action.

Typically offered in Fall only

PSY 757 Innovation and Technology (3 credit hours)
Social science theory and research on innovation process and consequences of deploying and implementing technologies. Interactions between social and technical systems: R&D management; social/ administrative technology; adoption and dissemination; public policy; computer-mediated communications; implementation; and intended and unintended outcomes for individuals, organizations and society.

Prerequisite: 3 hrs. grad. ST or research methods
Typically offered in Fall only

PSY 758 Special Topics in Applied Social and Community Psychology (3 credit hours)
Exploration of advanced specialized topics in Applied Social and Community Psychology to enhance in-depth graduate training in specific applied theories and methods. Seminar content will rotate, with attention to the development and evaluation of interventions to address important problems in individuals' well-being in society, particularly those faced by underrepresented groups. Graduate standing is required.

Prerequisite: 6 credit hours in GRAD PSY
Typically offered in Fall and Spring

PSY 760 Psychometrics (3 credit hours)
Theoretical and statistical approaches to understanding psychological measurement. Topics include detailed coverage of reliability, validity, and factor analysis.

Prerequisite: Six hours of graduate statistics, including linear regression
Typically offered in Fall only

PSY 761 Advanced Psychometrics: Item Response Theory (3 credit hours)
Item Response Theory approaches to advanced test construction and scoring; the investigation of test bias via item response theory methods.

Prerequisite: PSY 760

PSY 762 Quasi-Experimental Evaluation Design (3 credit hours)
An introduction to quasi-experimental design as applied to HRD program evaluation: (1) Methods of assessing informational needs, (2) recognition of internal and external validity threats, (3) design of quasi-experiments to minimize threats and (4) use of results by program decision makers.

Prerequisite: ST 507
Typically offered in Spring only

PSY 764 Industrial Psychology (3 credit hours)
Issues in psychology literature surrounding the person, organization, and job. Work analysis and design, recruitment, selection, training, and performance appraisal of employees. Emphasis on scientist-practitioner model throughout the course. Graduate standing or PBS status.

Typically offered in Fall only

PSY 766 Personnel Selection Research (3 credit hours)
A survey of theoretical, methodological and research literature on personnel selection. Topics include organization, task and person analyses, validation strategies, utility and equal opportunity issues and selection strategies. Emphasis on research.

Prerequisite: Six hrs. of grad. ST, PSY 760
Typically offered in Fall only

PSY 767 Training Research (3 credit hours)
A survey of conceptual and research literature on training. Topics include needs assessments, learning, transfer, maintenance, criterial and evaluation issues, as well as a review of research on specific training techniques. Emphasis on research methods and findings, not skill development in specific training techniques.

Prerequisite: Six hrs. of grad. PSY and six hrs. of grad. ST
Typically offered in Fall only

PSY 768 Organizational Psychology I (3 credit hours)
A survey of the application of behavioral science, particularly psychology and social psychology literature and research to organizational and management problems. Topics include work motivation and attitudes, job design, employee organizational commitment and work engagement.

P: ST 511 and 512
Typically offered in Spring only

PSY 769 Work Motivation (3 credit hours)
Theory and research in work motivation. An in-depth examination of motivation theory as it pertains to the study of individual behavior in work settings.

Prerequisite: PSY 768
Typically offered in Spring only

PSY 770 Organization Development and Change (3 credit hours)
A survey of theory and research in organization development. Attention directed to: (1) methods of diagnosing need for organizational change, (2) techniques currently used to implement and evaluate organizational change, (3) professional ethics and other issues dealing with client-consultant relationship. Emphasis on developmental approaches originating from psychology and allied fields.

Prerequisite: PSY 768
Typically offered in Spring only

PSY 778 Organizational Psychology II (3 credit hours)
A survey of the applications of behavioral science, particularly psychology and social psychology literature and research to organizational and management problems. Topics will pertain to the role of leadership in individual, team, and organizational performance.

Typically offered in Fall only

PSY 785 Methodological Issues In Developmental Psychology (3 credit hours)
Methodological issues, research designs and statistical techniques in developmental psychology. Role and meaning of age as a research variable. Interpretation of research reports. Ethical issues.

Prerequisite: PSY 584 and 3 hrs. of grad. statistics
Typically offered in Spring only

PSY 786 Cognitive Development (3 credit hours)
Examination of research and theory in cognitive development. Primary focus on childhood, but implications for the entire life span addressed. Application of cognitive developmental principles in creating interventions and educational programs also discussed.

Prerequisite: PSY 584
Typically offered in Spring only

PSY 787 Social Development (3 credit hours)
Survey of current theory and research on the development of social behavior systems, including attachment, aggression, gender-role behavior, prosocial behavior. Attention to the role of social class, race and culture, and to contemporary phenomena such as day care, single-parent and dual-career families, child abuse.

R: Psychology Graduate Status or Permission of Instructor
Typically offered in Spring only

PSY 788 Adulthood and Aging: Cognitive and Intellectual Change (3 credit hours)
Critical examination of theory and research associated with the study of cognitive and intellectual change in adulthood and aging. Memory and learning, information processing, language, intelligence, social cognition and expertise.

Prerequisite:PSY 584 or PSY 508
Typically offered in Fall only

PSY 789 Socio-Emotional Processes In Adulthood and Aging (3 credit hours)
Current theory and research on social, emotional and personality development during adulthood and aging. Generally including self-concept and identity, interpersonal relations (friendship, marriage, parenting, work), control, coping and life satisfaction. Attention to gender, culture and contemporary issues in adult development and aging.

Prerequisite: PSY 584
Typically offered in Fall only

PSY 792 Psychology Of Families and Parenting (3 credit hours)
Special topics in the area, including family influences on cognitive development, effects of parental divorce on children, single-parenting, step-families, child abuse and ethnic/cultural differences in family functioning. A critical examination of traditional and contemporary parenting approaches and an introduction to family therapy.

Prerequisite: Nine hrs. grad. PSY or ED
Typically offered in Fall only

PSY 795 Stress and Coping (3 credit hours)
Discussion of current research findings and theories in area of psycho-social stress. Topics include: biology of the stress response, methodology, physical, behavioral and psychological reactions to stress, and relationships between personality and social support to the development of stress-related disorders.

Prerequisite: Two grad. PSY courses
Typically offered in Fall only

PSY 809 Psychology Colloquium (1 credit hours)
Typically offered in Fall only

PSY 820 Special Topics In Psychology (1-6 credit hours)
Course provides opportunity for exploration in depth of advanced areas and topics of current interest.

Prerequisite: 6 hrs. of PSY, Corequisite: 3 hrs. of ST
Typically offered in Fall and Spring

PSY 841 School Psychology Practicum (1-6 credit hours)
Clinical participation in interviewing, counseling, psycho-therapy and administration of psychological tests. Practicum to be concerned with adults and children.

Prerequisite: Twelve hrs. in grad. PSY, which must include clinical skill courses PSY 722 and PSY 723
Typically offered in Fall and Spring

PSY 846 Practicum in Industrial/Organizational Psychology (3 credit hours)
Procedures and techniques used by Industrial and Organizational Psychologists in the field. Students write work proposals, conduct interventions in field, and codument results. Review one or more I/O procedure step-by-step.

Prerequisite: PSY 764
Typically offered in Fall and Spring

PSY 851 Internship In Psychology (1-6 credit hours)
Supervised work experience in an appropriate setting with professional supervision in the field from a doctoral level psychologist with credentials and/or experience in the appropriate specialty in psychology. Experience consists of full time for one semester or half time for an academic year or equivalent time.

Prerequisite: Master's degree in PSY and approval of advisory committee
Typically offered in Fall and Spring

PSY 880 Directed Study In Psychology (1-6 credit hours)
Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student and not to be part of thesis or dissertation research. Credits Arranged

Typically offered in Fall and Spring

PSY 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planing for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PSY 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PSY 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Public Administration (PA)

PA 203/PS 203 Introduction to Nonprofits (3 credit hours)
Development of nonprofit organizations and the contributions of nonprofits in the U.S., other countries, and the international community; political, social, and economic roles of nonprofits; nonprofit governance; partnerships with government and other nonprofits; types of organizations in the nonprofit sector; contemporary policy issues. Service project with minor transportation costs.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PA 311 Public Policy Analysis and Evaluation (3 credit hours)
This course will be an introductory course for the study of policy analysis, i.e. the systematic study of political-issue problems and alternative policy choices. An individual semester-long project will be completed by each student that identifies a policy issue of interest to the student and various alternatives to implement or improve the policy. Students will measure outcomes of their alternative choices and choose a course of action based on anticipated outcomes.

Typically offered in Fall only

PA 312/PS 312 Introduction to Public Administration (3 credit hours)
Administration in city, state and national governments: effectiveness and responsiveness, involvement in policy areas, and issues of ethics and responsibilities.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

PA 332 Human Resource Management in Public Sector (3 credit hours)
PA 332 is a fundamental, comprehensive course designed to provide a view of the major influence human resources management has in a productive public sector organization. Specifically, it examines the challenges of managing complex work systems in the political and institutional environments. Emphasis is given to the challenges facing the public sector in attracting and developing human assets in an environment of conflicting goals, stakeholder obligations and a highly aware electorate. With theoretical concepts established, the focus will shift to practical implementation tools to include recruitment, retention, compensation, and evaluation techniques.

Typically offered in Spring only

PA 410 Public Administration for Police Supervisors (3 credit hours)
Introduces law enforcement supervisors to the subject of Public Administration as a field of intellectual inquiry and as a field of professional activity. Students will learn how important founding principles such as federalism, separation of powers, equity, and democratic accountability impact police organizations today. The more practical concerns of police administrators including budgeting and financial management, labor-management relations, and personnel law are also considered. Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 411 Managing Police Organizational Behavior (3 credit hours)
This course is designed to prepare police managers to develop more efficient and effective organizations. Particular attention is given to improving leadership and interpersonal communication skills through self assessment. Students will also study group dynamics, team building, and the importance of employee empowerment within a law enforcement context. Problem-solving g tools and assessments utilized by police agencies to facilitate organizational change are also considered. Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 412 Management Skills & Practices for Police Supervision (3 credit hours)
The purpose of this course is to introduce law enforcement supervisors to management skills that can enhance their individual and organizational effectiveness. Students will learn collaborative leadership, conflict resolution, staff development, group problem solving, delegation and coaching. The skills taught in this class are considered theoretically (through reading assignments and lectures), experientially (through role plays, assessment center exercises, and management inventories), and analytically (through written analyses and class discussions). Available only to distance education students enrolled in the AOMP.

Typically offered in Fall, Spring, and Summer

PA 420 State and Local Economic Development Policy (3 credit hours)
In many communities, both rural and urban, the most immediate policy problem confronting public leaders is how to improve the local economy. The purpose of this course is to introduce public leaders to the tasks and challenges in policy development for improving the economies of communities. This course introduces students to the strategies fir attracting and retaining public and private investments in a local economy. An individual semester long project will be completed by each student that presents an original economic development strategy, program or project for a specific community (city/town or county).

Typically offered in Spring only

PA 498 Special Topics in Public Administration (3 credit hours)
Offered as needed to engage professional literature not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

PA 507 The Public Policy Process (3 credit hours)
Application of current theories of the public policy process to current issues in public policy and management. Emphasis on the dominant theories of the process, including policy streams, advocacy coalitions, punctuated equilibrium, institutional and rational choice models. Graduate standing or seniors with instructor's permission.

Typically offered in Fall only

PA 509 Applied Political Economy (3 credit hours)
Principles governing the interaction of politics and markets, and their application to public policy and public administration. Economic and political market failure, dilemmas of public choice and effects of political institutions. Case studies ofpublic policy-making.

Prerequisite: EC/ARE 401
Typically offered in Fall only

PA 510 Public Administration Institutions and Values (3 credit hours)
Exploration of the critical roles public administration plays in the American constitutional system of government with emphasis on public institutions, policy making and implementation, intergovernmental and intersectoral relations, public service values, administrative discretion, and ethical responsibilities and decision-making.

Typically offered in Fall and Spring

PA 511 Public Policy Analysis (3 credit hours)
Methods and techniques of analyzing, developing and evaluating public policies and programs. Emphasis given to benefit-cost and cost-effectiveness analysis and concepts of economic efficiency, equity and distribution. Methods include problem solving, decision making and case studies. Examples used in human resource, environmental and regulatory policy.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

PA 512 The Budgetary Process (3 credit hours)
Examination of generalized budgetary process used at all levels of government in the U. S. Understanding of the process based upon comprehension of institutions involved, roles of politicians and professionals and the objectives of budgetary systems. Focus also upon budgetary reforms and on Planning-Programming-Budgetary and Zero-Based Budgeting as management tools.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Summer

PA 513 Public Organization Behavior (3 credit hours)
Major conceptual frameworks developed to understand organization behavior. Motivation, leadership, group dynamics, communication, socio-technical systems, work design and organizational learning. Application of theories and concepts to public sectororganizations.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

PA 514 Management Systems (3 credit hours)
Use of management systems by public and nonprofit organizations to monitor and manage their programs. Results-based management approaches, including strategic planning, goal setting, and output/outcome measurement. Ways of increasing managerial effectiveness through the use of structural changes, process improvements, project planning tools, performance-based budget systems, and individual and group rewards.

Prerequisite: Six hours of graduate PA course work
Typically offered in Fall and Spring

PA 515 Research Methods and Analysis (3 credit hours)
A focus on behavioral approach to study of political and administrative behavior. Topics including philosophy of social science; experimental, quasi and non-experimental research design; data collection techniques; basic statistical analysis with computer applications.

Prerequisite: ST 311
Typically offered in Fall and Spring

PA 516 Effective Communications for Public Administrators (3 credit hours)
Focus on professional written and oral skills and the applications needed by public and nonprofit administrators. This includes drafting, editing, and presenting factual and persuasive materials. Use of visual aids, handling question and answer sessions, dealing with media, and holding effective meetings. Composing memos, position papers, and press releases. The course develops competency to communicate and interact productively with a diverse and changing workforce and citizenry.

Typically offered in Fall and Spring

PA 517 MPA Capstone (3 credit hours)
Students will demonstrate their achievement of core competencies developed through their MPA course of study. The course will include three key components: (1) Academic Portfolio; (2) Capstone Project; and (3) Reflection Essay. Students will develop a professional academic portfolio in which they identify activities and assignments from their course of study that demonstrate their attainment of the program's expected learning outcomes. Students will complete a hands-on, supervised course project focusing on a major public service problem or issue and that demonstrates practical application of core competencies. Students will prepare a reflection essay of what they learned in the MPA program during their preparation for a public service career.

P: PA 510, PA 511, PA 512, PA 513, PA 514, PA 515 and PA 516.
Typically offered in Fall and Spring

PA 520 Seminar in Urban Management (3 credit hours)
A seminar focusing on analytical techniques and managerial principles required for policy formation and implementation in a complex urban governmental environment. Specific topics including urban planning and community development, housing, intergovernmental relations, organizational roles and decision making, budgeting and selected urban services (for example: police, transportation).

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 521 Government and Planning (3 credit hours)
The planning function at all levels of government in the U. S., with particular attention to problems posed for planning by rapid growth of metropolitan areas. Overview of community development, urban spatial structure, housing economics and land use planning.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 522 Intergovernmental Relations in the United States (3 credit hours)
Examination of distinctive features of intergovernmental relations in the U. S. Topics stressed including historical adaptations of federalism, emerging role of the administrator, contemporary trends in intergovernmental relations and assessment of contemporary trends from federal, state and local perspectives.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

PA 523 Municipal Law (3 credit hours)
A focus on the legal nature of cities as municipal corporations and the legal context in which local governments operate. Specific topics covered including incorporation, ethics, public access to meetings and records, annexation, land use, development, planning, liability, financing, contracting, and personnel actions.

Prerequisite: Graduate standing
Typically offered in Fall only

PA 525 Organizational Development and Change Management (3 credit hours)
This course provides an introduction to the applied skills and knowledge necessary for helping public and nonprofit organizations and agencies effectively manage change. Students will gain knowledge and skills in organizational assessment, action research, systems change, and the stages of change management. Graduate standing only.

Typically offered in Spring only

PA 530 Financial Management in the Public Sector (3 credit hours)
Survey of financial practices and concepts in the public sector. Topics including public sector accounting, financial information systems, revenue projections, cash management and debt management. Emphasis upon case-based applications.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

PA 531 Human Resource Management in Public and Nonprofit Organizations (3 credit hours)
Analysis of major Human Resource practices used by public and nonprofit organizations. Techniques examined include organization (strategy, job analysis, job evaluation, and compensation), staffing (recruitment, retention, testing, and hiring), performance management (appraisal and training & development), and employee relations (grievance & discipline mediation & negotiation, and labor relations).

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

PA 532 Contract Negotiation and Mediation in the Public and Nonprofit Sectors (3 credit hours)
Three inter-related leadership skills - negotiation, contracting, and mediation-essential for acheiving organizational success. Skills for negotiating with partners, for facilitation among colleagues, for crafting and monitoring contracts for equipment, services, or performance, and for using alternate dispute resolution techniques, primarily mediation.

Prerequisite: Graduate standing or Management Development Certificate Program and 6 hours of 500-level course work
Typically offered in Spring only

PA 535 Problem Solving for Public and Nonprofit Managers (3 credit hours)
The course introduces a problem solving model specific to public and nonprofit organizations. The model is based on meeting three criteria: effectiveness, efficiency, and equity. Students learn to apply the model in interpersonal and group interactions. The course relies heavily on self-assessment to enable the students to recognize their problem solving propensities and the strengths and limitations of those tendencies.

Prerequisite: PA 513
Typically offered in Fall only

PA 536 Management of Nonprofit Organizations (3 credit hours)
Strategies for developing board leadership, staffing, and managing volunteers, working in multi-cultural environments, developing partnerships with other organizations, conducting government relations. Legal requirements and contraint on nonprofits: incorporation, lobbying, and tax policies.

Restriction: PBS status for Graduate Standing
Typically offered in Fall and Spring

PA 538 Nonprofit Budgeting and Financial Management (3 credit hours)
Nonprofit budgeting and financial management practices, including budgeting, financial analysis, cash flow forecasting, internally controlling financial transcations, borrowing, external auditing, investing, managing risk, purchasing and inventory control.

Typically offered in Spring only

PA 539/COM 539 Fund Development (3 credit hours)
Identifies and assesses techniques and best practices of fund development, annual giving, capital campaigns, endowments. Topics include setting achievable goals, organizing and staffing a fund development campaing, and identifying donors. Discusses links between fund development and organization mission and governance, ethical issues, and government regulations. PBS status or Graduate standing.

Typically offered in Fall only

PA 540 Grant Writing for Public Administrators (3 credit hours)
Survey of funding environment; how to identify foundations, corporation and government funding sources, write proposals, and evaluate proposals.

Typically offered in Fall only

PA 541 Geographic Information Systems for Public Administration (3 credit hours)
Introduction to management of spatial data in relation to public administration databases, including preparation of maps, tables, and data graphics related to geographic information systems in the public sector. Use of ArcView and a variety of other GIS computer applications.

Prerequisite: Graduate standing, PBS status, Advanced Undergraduate standing with 12 hours in PS program
Typically offered in Spring only

PA 545 Administrative Law (3 credit hours)
Case law of exercise of administrative power, judicial and legislative control of administrative action, legal rights of public employers and legal procedures of administrative tribunals.

Prerequisite: Graduate standing or PBS status

PA 546 Seminar in Program Evaluation (3 credit hours)
Combination of seminar and field research techniques to study evaluation of public programs. Focus on political and administrative problems associated with program evaluation. Examination of availiability and appropriateness of various quantitative methodologies. Seminar concepts applied through evaluative projects conducted for public agencies.

Prerequisite: Graduate standing and 6 hours of 500-level courses
Typically offered in Spring only

PA 550 Environmental Policy (3 credit hours)
Focus on formation and impact of environmental policy in the U. S. Examination on decision-making processes at all levels of government. Comparisons between political, economic, social and technological policy alternatives. Emphasis upon applicationof policy analysis in environmental assessment and consideration on theoretical perspectives on nature of the environmental crisis.

Prerequisite: Advanced Undergraduate standing including 12 hours of PS program, Graduate standing or PBS status
Typically offered in Fall only

PA 551 Energy Policy (3 credit hours)
This course provides an introduction to U.S. energy policy, using a contemporary electric utility Integrated Resource Plan (IRP) as both a conceptual and weekly roadmap. By way of the IRP, the course reviews the critical technical, economic, and public policy considerations that go into development and operation of an electric utility's generation portfolio. The first part of the course emphasizes the policy context of energy supply and consumption, including utility choice of generation technology, projected load growth, the economics of electricity generation and distribution, power purchase and contracting, and compliance with environmental regulations and requirements. The second half of the course takes the form of an extended group exercise, in which students will develop alternatives to the utility IRP, defending their scenarios and findings at a hypothetical Utilities Commission hearing. In between, guest lectures will add real-world context to the material discussed in class.

Typically offered in Spring only

PA 552 Science and Technology Policy (3 credit hours)
This course explores multiple methodologies and disciplinary perspectives to examine the public policies involving or affected by science and technology (S&T). Course themes include the history and evolution of S&T policy, current national and international S&T policy systems and the interactions and conflicts within and surrounding them, and responsible governance of S&T.

Prerequisite: Graduate Standing or PBS Status
Typically offered in Spring only

PA 553 Disaster, Crisis and Emergency Management and Policy (3 credit hours)
Study of the policies designed to prepare for, respond to, mitigate, and recover from natural and technological hazards, disasters, accidents, or terrorist attacks. Surveys government, nonprofit, and private sector activities in hazards, disasters,emergency and crisis management and policy.

PA 555 Administration of Criminal Justice (3 credit hours)
Politics and administration in American criminal justice system. Emphasis upon interrelationships between ideology, organization and policy outputs in analysis of major problems confronting the system today. Topics including intergovernmental relations, discretionary justice, impact of judicial decisions on criminal justice administration and management trends in criminal justice bureaucracies.Credit for both PS 555 and PA 555 is not allowed.3

Prerequisite: PS 311 or Graduate standing
Typically offered in Fall and Spring

PA 580 Independent Study (1-3 credit hours)
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 598 Special Topics in Public Administration (1-6 credit hours)
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

Prerequisite: Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 635 Readings and Research (1-3 credit hours)
To enable graduate students to pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PA 650 Internship in Public Affairs (1-6 credit hours)
Exposure of the student to environment and value systems of the public organization through a supervised work experience. Involving application of substantive knowledge and analytical skills to organizational problems. Credit will vary with nature of the work experience.

Prerequisite: Minimum 9 hours graduate work
Typically offered in Fall, Spring, and Summer

PA 651 Advanced Practical Training (1-3 credit hours)
Substantive knowledge and analytical skills applied to projects under agency supervision. Participation in monthly on-campus meetings. Credit will not be given for placements in current or previous work unit. Credit will not be given for both PA 650 and PA 651. Credit will vary with number of work hours. Must have MPA, current or previous professional work experience.

Prerequisite: 12 graduate credit hours
Typically offered in Fall, Spring, and Summer

PA 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

PA 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring and Summer

PA 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring and Summer

PA 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

PA 714 Public Administration Research Methods and Traditions (3 credit hours)
This course explores a variety of topics, ranging from the philosophy of social science to tailoring a literature review. The goal of this course is to approach the public administration research craft from a variety of perspectives, though their underlying epistemic assumptions are often not made explicit. The course also incorporates material on the responsible conduct of research.

Typically offered in Fall only

PA 715 Quantitative Policy Analysis (3 credit hours)
Application of quantitative tools to conduct public policy and administrative research. Course identifies and uses secondary data, including U.S. Census Data, to empirically assess social and economic policies. Emphasis is on the correct selection, use and interpretation of data to answer public policy questions and to understand the strengths and limitations of quantitative analysis.

Prerequisite: ST 407, ST 511, ST 513
Typically offered in Fall only

PA 761 Foundation of Public Administration (3 credit hours)
Intellectual foundation of public administration and its development as a discipline. Boundaries between public administration and large political process, external political control, factors producing administrative influence and the bases of administrative ethics.

Prerequisite: Graduate standing
Typically offered in Fall only

PA 762 Public Organization Theory (3 credit hours)
Examination of fundamental questions guiding organization research in public administration with emphasis on reconciling democracy and organization. Analysis of classical bureaucratic systems, rational choice, cognitive and organizational economic,and nonlinear and chaos theories.

Prerequisite: Graduate standing
Typically offered in Spring only

PA 763 Public Policy Process (3 credit hours)
Examination of public policy process at federal level in the United States. Analysis of constitutional foundations of this process and the role of governmental institutions, political culture, parties, interest groups, and public opinion in policy making. Case studies of policy making and implementation in selected policy areas.

Prerequisite: Graduate standing
Typically offered in Fall only

PA 764 Budgeting and Financial Management (3 credit hours)
Examination of budgetary and financial management processes in governmental and nonprofit agencies. Budgetary and financial management theory, practice, and unanswered research questions.

Prerequisite: PA 512
Typically offered in Spring only

PA 765 Quantitative Research in Public Administration (3 credit hours)
Review of quantitative procedures commonly applied in public administration with emphasis on applications found in leading journals in the discipline. Exploration of data acquisition, appropriate research design, selection of procedures, data assumptions of procedures, and common errors in the research process and in statistical analysis.

Prerequisite: PA 515 ; ST 507
Typically offered in Spring only

PA 766 Advanced Quantitative Research in Public Administration (3 credit hours)
Review of advanced quantitative procedures commonly applied in public administration research with emphasis on multivariate models found in leading journals in the discipline. Illustrative topics include the application of specialized regression models, generalized linear models, event history models, mixed and multilevel models, and structural equation models to topics in public administration.

Prerequisite: PA 765
Typically offered in Fall only

PA 770 Contemporary Public Management (3 credit hours)
Current public management practices, including evaluation of their underlying theoretical assumptions and of empirical evidence about their effectiveness. Causes of recent shifts in public management theory; political implications of management choices; privatization in theory and practice; managerial use of performance measurement systems; customer feedback systems; worker incentive structures.

Prerequisite: PA 514
Typically offered in Spring only

PA 771 Seminar on Nonprofit Organizations (3 credit hours)
Course provides the necessary theoretical foundation to design scholarly research on nonprofit organizations, voluntary action, and the nonprofit sector. Topics focus on the historical and philosophical roots of the nonprofit sector, the theories used to frame scholarly research and answer contemporary research questions. Students assume a leadership role in shaping the course content. Doctoral students only.

PA 780 Independent Study (1-3 credit hours)
Independent research or readings by graduate students under direct supervision of individual faculty members. Students' work evaluated, based on reports, papers and exams.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 798 Special Topics in Public Administration and Policy (1-6 credit hours)
In depth exploration of specialized or emerging topics in public administration or public policy. Student presentations on readings and research projects. Also used to test and develop new courses.

Typically offered in Fall and Spring

PA 803 Advanced Research Design (3 credit hours)
Philsosphy and objectives of social scientific research with focus on basic and applied research, need for hypothesis development and testing as a basis of scientific research, inductive and deductive reasoning. Emphasis on preparation of research design of dissertation, published articles, and technical presentations. Students will present a research prospectus that will serve as the basis for their dissertation.

Prerequisite: Doctoral student in Public Administration; PA 765, Corequisite: At least two graduate methodology or statistics courses
Typically offered in Fall only

PA 810 Special Topics in Public Administration (1-6 credit hours)
Detailed investigation of contemporary topics in fields of public administration. Topic and mode of study determined by program faculty.

Prerequisite: Advanced Undergraduate standing including 12 hours in PS program, Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

PA 835 Readings and Research (1-3 credit hours)
To enable graduate students to pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

PA 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

PA 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Summer only

PA 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PA 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

PA 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

PA 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Religious Studies (REL)

REL 200 Introduction to the Study of Religion (3 credit hours)
Historical, theoretical, and methodological introduction to the study of religion. Critical analysis of development of the discipline of Religious Studies. Preparation for all advanced study in Religious Studies theory and method, as well as training to study religious traditions of the world.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 210 Religious Traditions of the World (3 credit hours)
Major Eastern and Western religious traditions with attention to their basic teachings and practices as well as to the historical, geographical, social, and political settings in which they have arisen and developed.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 220 Religion in the Contemporary World (3 credit hours)
Engagement of diverse religious traditions with the contemporary world. Examination of topics such as religion and the environment, science, women and gender, the state, justice and conflict.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 230 Asian Religions (3 credit hours)
Asian religious traditions in comparative perspective. Religious and cultural history through literature, film, and art o India, Pakistan, Bangladesh, Sri Lanka, Nepal, Afghanistan, China, Japan, Korea, and other countries in the region. Doctrine, practice, teaching tales, and issues of change and conflict.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 298 Special Topics in Religious Studies (3 credit hours)
Selected studies in religion that do not appear regularly in the curriculum. Topics will be announced for each semester in which the course is offered.

REL 309/SOC 309 Religion and Society (3 credit hours)
Religious beliefs, practices and organizations addressed as social phenomena. Structural functionalism, conflict and subjectivism as theoretical orientations for understanding influences between religion and society. Relationship of religions to family, government, and economy and to social divisions, conflict and change.

P: 3 credits in SOC at the 200 level
GEP Humanities, GEP Social Sciences
Typically offered in Fall and Spring

REL 311 Introduction to the Old Testament (3 credit hours)
Study of Old Testament books [=Hebrew Bible, HB], examining their content, background and development. Comparisons of the biblical material with other Ancient Near Eastern literature. Assessment of contributions from archaeology and literary studies for clarifying the text. No prior knowledge of the subject matter is required.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

REL 312 Introduction to the New Testament (3 credit hours)
Literary and historical study of the New Testament in its Jewish and Greco-Roman contexts. Special attention to distinctive characteristics of the Gospels and their relationships, early controversies with Judaism and the emergence of church structure and teaching.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall, Spring, and Summer

REL 314 Introduction to Intertestamental Literature (3 credit hours)
Intertestamental literature in the context of Jewish history, institutions and beliefs of the Intertestamental Period (ca. 300 B.C.-ca. 100 A.D.)

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 317 Christianity (3 credit hours)
Development of Christianity from its origins to the present; events, persons, ideas, beliefs and practices which were most significant in this development.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 320/HI 320 Religion in American History (3 credit hours)
Representative people, movements and thought in the major religions within the context of American society and culture.

GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

REL 323 Religious Cults, Sects, and Minority Faiths in America (3 credit hours)
Religious cults, sects and minority faiths in America, including Mormonism, Christian Science and Jehovah's Witnesses. Also covers such alternate groups as the holiness-charismatic movement and the Unification Church. Origins, development and teachings of these groups within the context of American culture and religion.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

REL 327 Issues in Contemporary Religion (3 credit hours)
Responses of contemporary Western religious thinkers to critics of religion and to challenges posed by the 20th century including the Nazi Holocaust, social injustice (liberation theologies - black, feminist, Third World), ecological crisis, threat of nuclear warfare, and conflicts between religions.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 331 The Hindu Tradition (3 credit hours)
Basic religio-philosophical concepts, social institutions, and individual practices of Hindu civilization from earliest Vedic times to the present. Focus on major traditions: Action (karma), Knowledge (jnana), and Devotion (bhakti), with emphasis on disciplines (yoga), myth, symbol, art.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 332 The Buddhist Traditions (3 credit hours)
History and structure of the Buddhist tradition analyzed through the "three jewels": the Buddha, the Monastic Community (sangha), and the Teachings (dharma). Emphasis on fundamental religio-philosophical concepts, social history and ritual practices of Southern Buddhism, early Mahayana development, and Tantric ideals. Growth of the traditions in China and Japan.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 333 Chinese Religions (3 credit hours)
Survey of Chinese religions from prehistoric times to present. Confucianism, Daoism, primary Buddhist schools in China, spirit possession, divination and popular religious worship.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 334 Japanese Religions (3 credit hours)
Survey of various strands of Japanese religious life from prehistoric times until present. Kami worship; primary Buddhist schools in Japan; Japanese Christianity; Confucianism; and New Religions.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 340 Islam (3 credit hours)
Introductory survey of the Islamic religious tradition. Examination of the primary historical, literary, and theological sources for Islamic religious thought in global contexts. Topics include the Prophet Muhammad, the development of the early Muslim community, Islamic religious practice, Sunni and Shi'i Islam, Sufism, theology, law and Islamic art and architecture.

GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 343/AFS 343 African American Religions (3 credit hours)
History of religions among Americans of African descent from the period of the development of the transatlantic slave trade to the present. Exploration of the complex ways religion has shaped the lifeworld of African Americans.

GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

REL 350 Introduction to Judaism (3 credit hours)
A survey of Jewish religious traditions from the bible through the present day. Evolution of major religious ideas through classical texts including torah, Talmud, philosophical and mystical literature, and contemporary fiction.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 380 Emotion and Religion (3 credit hours)
The application of theories of emotion and specific emotions (such as wonder, grief, anger and fear) to the study and practice of religion and to the relationship of religion to race, gender, class and politics.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

REL 383 Religion, Globalism, and Justice (3 credit hours)
Issues and problems in religion and societies since 1945. Historical, theoretical, sociological, and cultural approaches to globalism and religion. Inquiry into the role of ethical reasoning in religious debates on the problem of globalization.

GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 402/HI 402 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox Christian movements; anti-heretical writings; orthodox institutions of authority. Students may not receive credit for both REL /HI 402 and REL/HI 502.

Prerequisite, one of: REL 312, REL 317, or HI 207.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 407/HI 407 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: 3 hrs HI or REL 300 or above
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 408/HI 408 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.

Prerequisite: 3 hours of history or religious studies
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 412 Advanced Readings in the Christian Gospels (3 credit hours)
Close study of the varieties of gospel writings, both canonical and non-canonical, in early Christianity. Analysis of the constituent features of the gospels (parables, healing narratives, sermons), and their "pre-history"; the use of the gospels in the reconstruction of the life and ministry of Jesus; and critical methods in gospel research. Students may not receive credit for both REL 412 and REL 512.

P: REL 312 or REL 317
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 413 The Life and Letters of the Apostle Paul (3 credit hours)
Intensive study of the apostle Paul and his writings in their historical, literary and religious contexts. Sources for the life and ministry of Paul; the structure and theology of the Pauline and deutero-Pauline epistles; the influence and image of Paul in early Christianity; and contemporary controversies and issues in the study of Paul. Students may not receive credit for both REL 413 and REL 513.

P: REL 312 or REL 317
GEP Global Knowledge, GEP Humanities
Typically offered in Fall only

REL 423 Religion and Politics in America (3 credit hours)
Issues and problems in religion and politics in the United States since 1900. Historical, theoretical, sociological, and cultural approaches to religion and politics. Inquiry into the relations between religion and the state. Responses of religious traditions to American social and political issues. Students cannot receive credit for both REL 423 and REL 523.

Prerequisite for REL 423: one 300-level course in religion, philosophy, or history
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

REL 424 Religion and Politics in Global Perspective (3 credit hours)
An interdisciplinary investigation of interfaces between religion and politics in select global hotspots. Possible topics include governmental systems, constitutional law, war, disaster, and development.
Prerequisites: For REL 424, 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC; for REL 524, graduate standing.

Prerequisite: 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 471/STS 471 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in anevolutionary world.

Prerequisite: One course in religious studies, biological sciences, philosophy of science, or history of science. Credit is not allowed for both REL 471 and REL 571.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

REL 472/WGS 472 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: one course in religious studies or women's and gender studies
GEP Humanities
Typically offered in Spring only

REL 473/WGS 473/REL 573/WGS 573 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for more than one of: REL 473, REL 573, WGS 473, WGS 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS). Credit is not allowed for more than one of REL 473, WGS 473.
Typically offered in Fall only

REL 482 Religion and Conflict (3 credit hours)
Critical and theoretical inquiry into religious violence and nonviolence. Source materials on violence and nonviolence from histories and texts. Case studies of inter- and intra-religious conflict and violence, including both US and non-US religious traditions. Conflict resolution and role of religion in peacebuilding. Politics and public policy of religion, violence, and conflict. Credit cannot be earned for both REL 482 and REL 582.

Prerequisite: A 300 or above level Religion course
GEP Global Knowledge, GEP Humanities
Typically offered in Spring only

REL 489 Interpretations of Religion (3 credit hours)
Theory and method in the study of religion. Historical survey of the discipline of religious studies. Investigation of the major schools of interpretation and themes of study. Application of methodologies to historical and sociological case studies, involving both US and non-US religious traditions. Students cannot receive credit for both REL 489 and REL 589.

P: One course in religion, philosophy, anthropology, history, or sociology.
GEP Global Knowledge, GEP Humanities
Typically offered in Fall and Spring

REL 496 Seminar in Religious Studies (3 credit hours)
Advanced research and writing in selected topics; application of contemporary and historical methods for the study of religion; hermeneutic theory. Open primarily to Religious Studies majors and minors

Prerequisite: 300-level course in Religion

REL 498 Special Topics in Religious Studies (1-6 credit hours)
Detailed investigation of selected topics in religion. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study programs.

Prerequisite: 6 hours REL

REL 502/HI 502 Early Christianity to the Time of Eusebius (3 credit hours)
Growth and diffusion of early Christianity from the end of the first century up to the time of Eusebius and the conversion of Constantine (early fourth century); Christianity in its Greco-Roman environment; Roman policy towards Christianity; heterodox Christian movements; anti-heretical writings; orthodox institutions of authority. Students may not receive credit for both REL /HI 402 and REL/HI 502.

Prerequisite: Graduate standing
Typically offered in Fall only

REL 507/HI 507 Islamic History to 1798 (3 credit hours)
The history of the Islamic Near East to 1798. Topics include the East Mediterranean before Islam, Muhammad and the development of Islam, sources of Muslim civilization, Islamic law, science, philosophy, art and architecture, Islam in Spain, India, Asia and Africa, the Crusades, the Ottomans, Islam and Europe. Credit will not be given for both REL/HI 407 and REL/HI 507.

Prerequisite: Graduate Standing
Typically offered in Fall only

REL 508/HI 508 Islam in the Modern World (3 credit hours)
Evolution of modern Islam from 17th century to the present. Primary emphasis on North Africa, the Middle East and South Asia. Pre-modern Islamicate empires, reform and revival. Historical origins of current issues in the Islamic world. Students cannot receive credit for both REL/HI 408 and REL/HI 508.

Prerequisite: Graduate Standing
Typically offered in Fall only

REL 512 Advanced Readings in the Christian Gospels (3 credit hours)
Close study of the varieties of gospel writings, both canonical and non-canonical, in early Christianity. Analysis of the constituent features of the gospels (parables, healing narratives, sermons), and their "pre-history"; the use of the gospels in the reconstruction of the life and ministry of Jesus; and critical methods in gospel research. Students may not receive credit for both REL 412 and REL 512.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

REL 513 The Life and Letters of the Apostle Paul (3 credit hours)
Intensive study of the apostle Paul and his writings in their historical, literary and religious contexts. Sources for the life and ministry of Paul; the structure and theology of the Pauline and deutero-Pauline epistles; the influence and image of Paul in early Christianity; and contemporary controversies and issues in the study of Paul. Students may not receive credit for both REL 413 and REL 513.

Prerequisite: Graduate standing
Typically offered in Spring only

REL 523 Religion and Politics in America (3 credit hours)
Issues and problems in religion and politics in the United States since 1900. Historical, theoretical, sociological, and cultural approaches to religion and politics. Inquiry into the relations between religion and the state. Responses of religious traditions to American social and political issues. Students cannot receive credit for both REL 423 and REL 523.

Prerequisite for REL 523: graduate standing
Typically offered in Spring only

REL 524 Religion and Politics in Global Perspective (3 credit hours)
An interdisciplinary investigation of interfaces between religion and politics in select global hotspots. Possible topics include governmental systems, constitutional law, war, disaster, and development.
Prerequisites: For REL 424, 3 credits in one or more of the following: ANT, COM, HI, IS, PS, REL, SOC; for REL 524, graduate standing.

R: Graduate Standing
Typically offered in Spring only

REL 571/STS 571 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in an evolutionary world. Credit is not allowed for both REL 571 and REL 471.

Prerequisite: Graduate standing. Credit is not allowed for both REL 571 and REL 471.
Typically offered in Fall only

REL 572/WGS 572 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: Graduate Standing
Typically offered in Spring only

REL 573/WGS 573/REL 473/WGS 473 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for more than one of: REL 473, REL 573, WGS 473, WGS 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS). Credit is not allowed for more than one of REL 473, WGS 473.
Typically offered in Fall only

REL 582 Religion and Conflict (3 credit hours)
Critical and theoretical inquiry into religious violence and nonviolence. Source materials on violence and nonviolence from histories and texts. Case studies of inter- and intra-religious conflict and violence, including both US and non-US religious traditions. Conflict resolution and role of religion in peacebuilding. Politics and public policy of religion, violence, and conflict. Credit cannot be earned for both REL 482 and REL 582.

Restriction: Graduate Standing
Typically offered in Spring only

REL 589 Interpretations of Religion (3 credit hours)
Theory and method in the study of religion. Historical survey of the discipline of religious studies. Investigation of the major schools of interpretation and themes of study. Application of methodologies to historical and sociological case studies, involving both US and non-US religious traditions. Students cannot receive credit for both REL 489 and REL 589.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

REL 598 Special Topics in Religious Studies (1-6 credit hours)
Detailed investigation of selected topics in religion. Topics determined by faculty members in consultation with head of the department. Course may be used for individualized study programs. Students cannot receive credit for both REL 498 and REL 598 unless the topic is different.

Typically offered in Fall, Spring, and Summer

Science, Technology and Society (STS)

STS 210/WGS 210 Women and Gender in Science and Technology (3 credit hours)
Interdisciplinary introduction to the reciprocal relationships between scientific/technological research and contemporary understanding of gender. Special emphasis on social factors influencing scientists and engineers in their professions.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

STS 214 Introduction to Science, Technology, and Society (3 credit hours)
Introduction to the field of Science, Technology, and Society (STS), including most important STS scholars, major schools of thought, and important theoretical and empirical issues in STS.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 257/ARS 257 Technology in the Arts (3 credit hours)
The interaction between technology and the arts with an emphasis on developments in Western art of the twentieth century. Historical and emerging issues include: sound and film recordings, the addition of sound to films, the impact of films and television on theater, the impact of radio, computer applications to music, the visual arts, and literature.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 301 Science and Civilization (3 credit hours)
An inquiry into the scientific achievement and cultural impact of three different, but interrelated, models (or paradigms) of understanding the world and man's place in it; the Ancient-Medieval model of Aristotle, Ptolemy and Aquinas; the 17th century model of Newtonian physics; and the emerging, but fragmentary, 20th century model based upon the new physics of Einstein, Planck and Heisenberg.

Requisite: Sophomore Standing or Above
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 302 Contemporary Science, Technology and Human Values (3 credit hours)
Interdisciplinary evaluation of recent and potential influences of current scientific and technological developments on US and non-US societies. Emerging social, ethical, and intellectual issues include: The adequacy of contemporary scientific frameworks; the relations among science, technology, and society; the social consequences of scientific and technological applications, and human prospects and possibilities.

Prerequisite: Sophomore standing
GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 304 Ethical Dimensions of Progress (3 credit hours)
Multidisciplinary examination of traditional western notion of progress, focusing on ethical issues raised by concept of progress, and connections between science, technology and society. Places relationships such as engineering and social responsibility within the context of present day redefinitions of the notion of progress.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 322 Technological Catastrophes (3 credit hours)
Interdisciplinary examination of the human, organizational and technical factors contributing to the causes and impacts of recent technological accidents such as the Bhopal chemical leak, the space shuttle Challenger explosion, the Chernobyl nuclear accident, and the Exxon Valdez oil spill. Evaluation of risk assessment, risk perception and risk communication strategies. Consideration of options for living with complex technological systems.

Prerequisite: Sophomore standing
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 323 World Population and Food Prospects (3 credit hours)
Examination of the dynamics of population size and food needs, production, distribution and utilization. Consequences of inadequate nutrition and food choices, efforts to increase the compatibility of effective food production systems and alternate crops and cropping systems examined.

GEP Global Knowledge, GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

STS 325/PHI 325 Bio-Medical Ethics (3 credit hours)
Interdisciplinary examination and appraisal of emerging ethical and social issues resulting from recent advances in the biological and medical sciences. Abortion, euthanasia, physician-assisted suicide, compromised infants, aids, reproductive technologies, and health care. Focus on factual details and value questions, fact-value questions, fact-value interplay, and questions of impact assessment and policy formulation.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 402 Peace and War in the Nuclear Age (3 credit hours)
An interdisciplinary examination of contemporary wars and international conflict, arms, races, nuclear strategy and defense policy, arms control, theories and strategies of peace.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

STS 403 Seminar in Science, Technology, and Society (3 credit hours)
Capstone course for the Science, Technology, and Society (STS) major. Review of the principal theoretical and empirical issues of the field. Research project focused on each student's STS specialty.

Prerequisite: STS 214, STS or STB Majors
Typically offered in Fall and Spring

STS 405 Technology and American Culture (3 credit hours)
Interdisciplinary study of the role of technology in American culture that examines the social, ideological, economic, and institutional contexts of technological change in nineteenth and/or twentieth-century America. Explores cultural impacts of transformative technological innovations, such as electricity, trains, telephones, radios, cars, airplanes, and computers, as reflected in popular cultural products like magazine/newspaper articles, advertising, literature, music, museum exhibits, and/or film.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

STS 471/REL 471 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in anevolutionary world.

Prerequisite: One course in religious studies, biological sciences, philosophy of science, or history of science. Credit is not allowed for both REL 471 and REL 571.
GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Fall only

STS 490 Issues in Science, Technology, and Society (3 credit hours)
Examination of a significant issue, method, or historical episode in the area of science, technology, and society.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

STS 491 Independent Study in Science, Technology, and Society (3 credit hours)
Independent investigation and discussion of a selected topic in science, technology, and society. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

STS 571/REL 571 Darwinism and Christianity (3 credit hours)
Evolutionary biology and Christianity. Darwin's evolutionary theory; neo-Darwinism; conflicts between evolutionary theory and Christian thought; methodological parallels and differences between science and religion; proposals for divine action in an evolutionary world. Credit is not allowed for both REL 571 and REL 471.

Prerequisite: Graduate standing. Credit is not allowed for both REL 571 and REL 471.
Typically offered in Fall only

Social Sciences (SSGE)

SSGE 295 Social Sciences Special Topics (3 credit hours)
Special topics course offering for the general education Social Sciences category.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

Social Sciences and Global Knowledge (SSGK)

SSGK 295 Social Sciences and Global Knowledge Special Topics (3 credit hours)
Special topics course offering for the general education Social Sciences and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Social Sciences (SS) requirement.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

Social Sciences and U.S. Diversity (SSUS)

SSUS 295 Social Sciences and U.S. Diversity Special Topics (3 credit hours)
Special topics course offering for the general education Social Sciences and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Social Sciences (SS) requirement.

GEP Social Sciences, GEP U.S. Diversity

Social Work (SW)

SW 201 Introduction to Social Work (4 credit hours)
This course, the basis for all other social work courses, provides an introduction to generalist practice and an overview of social work practice in a variety of settings. Successful completion of this course is a prerequisite for all advanced SW courses. This course is designed to acquaint students with social services typical of most American communities: what they are, who uses them, their impact, who pays for them, and who works in them. 40-hour pre-professional placement required, intern liability insurance required. Transportation to and from agency and/or community settings is the responsibility of the student.

GEP U.S. Diversity
Typically offered in Fall and Spring

SW 260 Introduction to Gerontology: An Interdisciplinary Field of Practice (3 credit hours)
An integrative seminar in introducing students to gerontology as an interdisciplinary field of practice. The course provides an overview of topics such as the demography of older adults and the physical, cognitive, and psychosocial aspects of aging. The course also covers health care and social policies that impact older persons and caregivers along with the aging network of services. Students will discuss forms of oppression such as ageism, sexism, racism, able-body(ism), and homophobia that impacts work with older people as well as strategies to promote social and economic justice.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Summer only

SW 290 The Development of Social Welfare and Social Work in the U.S. (3 credit hours)
This course reviews the major policy and program developments in American social welfare and the emergence and development of professional social work. Emphasis will be on the socio-cultural context of policy and programs, and the ideas and ideals that shape social welfare. In addition, the basic elements of social policy development will be considered. This course provides the history, mission, philosophy, and evolution of social welfare policies and services that form the foundation of social welfare, particularly as they relate to poverty, racism, and efforts to address the needs of oppressed and marginalized populations.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SW 300 Research Methods in Social Work (3 credit hours)
This course provides an overview of the principles and methods of basic social work research. Substantive research knowledge, including quantitative and qualitative research methodologies, are highlighted. Research ethics within the context of social work ethics and values are emphasized. The course introduces students to how high-quality research in social work is designed and conducted, as well as how research can assist in making important decisions about the design and implementation of projects, programs, and policies that address the social needs of diverse groups.

Prerequisite: ST 311
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SW 307 Social Welfare Policy: Analysis and Advocacy (3 credit hours)
This course introduces students to the processes by which social welfare policies are developed and implemented as well as the ways in which people can intervene to affect these processes. Students have the opportunity to review recent developments in national and state social welfare policies and programs in major areas such as poverty, welfare, social security, housing, health and mental health care, and child welfare. The course focuses on the development of students' policy analysis and advocacy skills.

Requirement: Junior Standing
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SW 310 Human Behavior Theory for Social Work Practice (3 credit hours)
This course is designed to introduce theory regarding human life/development for students intending to practice social work. Students learn to recognize ways in which diversity characterizes and shapes the human experience and is critical to the formation of identity, the extent to which a culture's structures and values may oppress, marginalize, alienate, create or enhance privilege and power. Course surveys major theoretical frameworks and normative developmental variations. Students learn to apply these theories and knowledge from the liberal arts to understand biological, psychological, social, cultural, and spiritual development. Transportation to and from agency and/or community setting is the responsibility of the student.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SW 312 Multicultural Social Work (3 credit hours)
Course prepares students to work with diverse groups of people locally and globally defined by gender, ethnicity, race, national origin, sexual orientation, income, physical and mental ability, age and religion. Emphasis is placed on defining and developing skills for culturally competent social work generalist practice with these populations through students' self-examination, experiential learning, and critical reading of class material. This course helps students develop competencies in critical self-reflection, multicultural values and ethics, knowledge, awareness and skills in a variety of ways so that they can work against manifestations of social injustice. Students are expected to provide their own transportation as needed.

GEP U.S. Diversity
Typically offered in Fall and Spring

SW 320 Social Work Practice I (4 credit hours)
First of a three-course sequence. Practice I presents the generalist social work practice method and focuses on interviewing skills, engaging clients in the helping process, and integrating theory and social work practice. It addresses ethical and professional standards and emphasizes understanding and applying systems and ecological frameworks to practice situations. It examines strengths-based assessment, the phases of the helping relationship, and the dynamics of change in interpersonal helping relationships, within a framework of human rights, social justice, and diversity. 40-hour preprofessional placement required; intern liability insurance required. Transportation to and from agency and/or community settings is the student's responsibility.

Corequisite: Social Work Majors, and a prerequisite or corequisite of SW 310
Typically offered in Fall, Spring, and Summer

SW 405 Social Work Practice II (4 credit hours)
Second of a three-course sequence (Practice I, II, and III). Practice II examines generalist social work roles and techniques with families and groups. Building on the foundation interviewing and engagement skills presented in Practice I, it focuses on assessment, planning, and intervention with individuals, families and small groups within a framework of human rights, social justice, and diversity. 40-hour preprofessional placement is required, intern liability insurance is required. Transportation to and from agency and/or community settings is the student's responsibility.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 480/SW 408
Typically offered in Fall and Spring

SW 408 Social Work Practice III (3 credit hours)
Course prepares students for practice will organizations, communities, policy structures, and institutions that are viewed as both tools and targets for change efforts. Course emphasizes multiculturalism, diversity, and social justice in relation to social systems. It is designed to provide social work practitioners with the means to help organizations and communities empower themselves to make change through networking, political participation, leadership development, mobilization, utilization of resources, and other strategies and techniques. Transportation to and/or from community settings is the responsibility of the student.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 480
Typically offered in Fall and Spring

SW 412/SW 512 Social Work in Schools (3 credit hours)
Models and roles relevant to school social work practice. Cooperative work with school personnel in the identification, prevention and treatment of social, emotional and behavioral problems of children and interventive techniques with parents and community groups. For individuals preparing for social work practice in the public schools and for school social workers seeking licensure. Credit not given for both SW 412 and SW 512. Instructor Permission Required.

Typically offered in Fall, Spring, and Summer

SW 413 African American Families: History, Tradition, and Community (3 credit hours)
Characteristics, traditions, history and strengths of African American families and their relationship to other social institutions, social advocacy and social policy development. African-centered worldview and relevant theory pertaining to best practice with African American families.

Prerequisite: Sophomore standing
Typically offered in Summer only

SW 415/SW 515 Child Welfare (3 credit hours)
Generalist perspective on the practice of public child welfare. History of child welfare, practices in child welfare, and current trends in child welfare programs. Skills needed to practice in child protective services, adoption, and foster care with specific attention to the North Carolina child welfare system. Application of cultural diversity and cultural competency integrated throughout as it relates to child welfare issues.

Prerequisite: SW 201
Typically offered in Fall, Spring, and Summer

SW 416/SW 516 Addiction Recovery and Social Work Practice (3 credit hours)
Knowledge and skills in identifying Alcohol and Other Drugs (AOD) problems, screening, assessment, intervention, referral, and prevention: history of AOD problems and treatment, AOD classification, effects and signs/symptoms of AOD, models of addiction, diversity, assessment, diagnosis, intervention, treatment modalities, mutual-help groups, family dynamics, prevention, and ethical considerations. Students cannot receive credit for both SW 416 and SW 516

Prerequisite: SW 310
Typically offered in Fall, Spring, and Summer

SW 417/SW 517 Direct Practice with Older Adults (3 credit hours)
Physical, psychological, social, and cultural theories of the aging process as it relates to social work practice, social policy, and services for working with older adults and their families. Emphasis on mental and physical well-being, diversity, social and economic justice, intergenerational issues, policy and programs. Credit is not allowed for both SW 417 and SW 517.

Typically offered in Fall and Spring

SW 418 Child Welfare Seminar (1 credit hours)
Best practice seminar for participants in the NC Child Welfare Education Collaborative Program. Seminars focus on current issues in child welfare practice and policy. Topics vary from semester to semester. Students arrange own transportation for occasional field trips to community agencies.

Prerequisite: Students are Participants in the NC Child Welfare Education Collaborative Program
Typically offered in Fall and Spring

SW 420 The Legal Aspects of Social Work (3 credit hours)
Legal environment of the social work profession. Relationships among legal processes, the delivery of social work services and client problems.

Prerequisite: Social Work Majors and Social Work Minors
Typically offered in Fall and Spring

SW 423/SW 523 Social Work with Soldiers, Veterans, and Their Families (3 credit hours)
A basic overview of military life and the issues and challenges faced by military personnel, their families, friends, and community. The course provides a foundational guide to help professionals working with military families and to understand and address these issues and challenges.

R: Junior or Senior standing. Sophomores and Non-Degree may enroll with instructor approval.
Typically offered in Fall and Spring

SW 425/SW 525 Hunger and Homelessness (3 credit hours)
This course will familiarize students with the history and experience of hunger and homelessness in contemporary American society. The course includes discussion, narrative readings, experiential exercises, movie reviews, field trips, and other media to expose students to issues of food insecurity and housing instability. Students will critique ideas of what it means to be "poor" and be exposed to the lives of individuals who do not have access to adequate food, housing, healthcare, and other basic needs. American social welfare policy, including governmental and local programs that address these issues, will be discussed. Students are responsible for transportation.

Restricted: Junior or Senior Standing. Sophomores and Non-Degree Students may enroll with instructor approval.
GEP U.S. Diversity
Typically offered in Fall and Spring

SW 440/SW 540 International Learning Experience in Social Work (6 credit hours)
A seven week learning experience in Guatemala. Through this course, the student will develop a global perspective of social welfare and social work practice, will learn about the people and culture of the Lake Atitlan area of Guatemala, will learn the variety of resources available in response to social need, and will enhance or develop Spanish language competence. All costs associated with learning opportunities and activities for this course are included in the cost of the program.

GEP Global Knowledge
Typically offered in Summer only

SW 480 Preparation for Field Work (1 credit hours)
Introduction to aspects of field placement process and necessary skills for a successful internship. Application, interview, ethical practice, documentation, supervision and learning contract.

Prerequisite: Social Work Majors, SW 320, Corequisite: SW 405, SW 408
Typically offered in Fall and Spring

SW 490 Field Seminar (3 credit hours)
Weekly integrative seminar taken in conjunction with SW 491, Community-Based Field Internship. Field seminar provides students the opportunity to discuss and reflect upon their practice of social work skills through dialogue and discourse facilitated by a faculty member who develops a professional environment for students to discuss and reflect upon their agency-based field placement experience. Through organized group discussion and assignments, students use critical reflection pedagogy to discuss their application of professional social work.

Prerequisites: Social Work Majors, SW 405, SW 408, and SW 480; Corequisite: SW 491
Typically offered in Fall, Spring, and Summer

SW 491 Community-Based Field Practicum (9 credit hours)
This nine-credit course is a co-requisite for, and is taken in conjunction with, SW 491 during the BSW student's final semester. Students must complete a range of 450 to 480 hours of supervised field agency practicum in an approved community-based agency. It serves as a direct practice component of the culmination of knowledge gained in the BSW courses. Field placement provides students the opportunity to practice social work skills under the supervision of a professional social worker and apply evidence-informed practices, with emphasis on social and economic justice, in their work with individuals, families, groups, organizations, and communities.

Prerequisites: SW 405 and SW 408 and SW 480; Corequisite: SW 490
Typically offered in Fall, Spring, and Summer

SW 495 Special Topics in Social Work (3 credit hours)
Detailed investigation of a topic in social work. Topic and mode of study determined by faculty member.

Typically offered in Fall, Spring, and Summer

SW 498 Independent Studies in Social Work (1-6 credit hours)
Independent or small group study of a social work practice or social welfare area. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing or Senior standing, Social Work Majors or Social Work Minor, Nine credits in social work courses
Typically offered in Fall, Spring, and Summer

SW 500 Advanced Standing Seminar (4 credit hours)
Orients advanced standing students to the Department and the MSW Program; provides connection between the BSW curriculum and advanced MSW curriculum; assures attainment of CSWE Foundation Curriculum Competencies; provides opportunities to demonstrate/ evaluate practice skills of engagement, assessment, intervention, and evaluation; assists students with successful entry into advanced MSW program of study and advanced field placement. For graduate students in the advanced standing program.

Corequisite: SW 505
Typically offered in Summer only

SW 501 Social Work Policy, Services and Programs (3 credit hours)
Provides students with an understanding of and critical perspective on the development of social systems, social policy and the profession of Social Work in the United States. Examination of the history, mission, philosophy, and evolution of social welfare polices and services that form the foundation of social welfare, particularly as they relate to poverty, racism, and efforts to address the needs of oppresses and marginalized populations.

Typically offered in Spring only

SW 505 Human Behavior and the Social Environment: Social Justice (3 credit hours)
Theoretical and experiential knowledge related to oppression, privilege, and social and economic justice. Particular attention is given to persons and groups most affected by oppression and mechanisms that advance the achievement of a more just society.

Typically offered in Fall and Summer

SW 506 Human Behavior and the Social Environment: Individuals, Families, and Groups (3 credit hours)
An overview of normative individual and family development trajectories through the life cycle and survey of major theoretical frameworks and normative development variations: Theories of individual, familial, and group interaction and ways that informal groupings and support networks function to maintain individual and family well-being and stability. Admission to the MSW program or permission of the instructor.

Typically offered in Fall only

SW 510 Research Methods for Social Work (3 credit hours)
This course prepares students to carry out evidence-based practice in social work by interpreting empirical research findings in the context of social work practice and using social work research methods. The major activities of the course include: (1) identification of human diversity and ethical issues in research design and implementation, (2) identification of the steps of the research process, (3) assessment of the strengths and weaknesses of empirical research studies, and (4) utilization of mixed methods in designing social work research and evaluation.

P: ST 311; R: Departmental approval required
Typically offered in Spring only

SW 512/SW 412 Social Work in Schools (3 credit hours)
Models and roles relevant to school social work practice. Cooperative work with school personnel in the identification, prevention and treatment of social, emotional and behavioral problems of children and interventive techniques with parents and community groups. For individuals preparing for social work practice in the public schools and for school social workers seeking licensure. Credit not given for both SW 412 and SW 512. Instructor Permission Required.

Typically offered in Fall, Spring, and Summer

SW 515/SW 415 Child Welfare (3 credit hours)
Generalist perspective on the practice of public child welfare. History of child welfare, practices in child welfare, and current trends in child welfare programs. Skills needed to practice in child protective services, adoption, and foster care with specific attention to the North Carolina child welfare system. Application of cultural diversity and cultural competency integrated throughout as it relates to child welfare issues.

Prerequisite: SW 201
Typically offered in Fall, Spring, and Summer

SW 516/SW 416 Addiction Recovery and Social Work Practice (3 credit hours)
Knowledge and skills in identifying Alcohol and Other Drugs (AOD) problems, screening, assessment, intervention, referral, and prevention: history of AOD problems and treatment, AOD classification, effects and signs/symptoms of AOD, models of addiction, diversity, assessment, diagnosis, intervention, treatment modalities, mutual-help groups, family dynamics, prevention, and ethical considerations. Students cannot receive credit for both SW 416 and SW 516

Prerequisite: SW 310
Typically offered in Fall, Spring, and Summer

SW 517/SW 417 Direct Practice with Older Adults (3 credit hours)
Physical, psychological, social, and cultural theories of the aging process as it relates to social work practice, social policy, and services for working with older adults and their families. Emphasis on mental and physical well-being, diversity, social and economic justice, intergenerational issues, policy and programs. Credit is not allowed for both SW 417 and SW 517.

Typically offered in Fall and Spring

SW 518 Child Welfare Seminar (1 credit hours)
Best practice seminar for participants in the NC Child Welfare Education Collaborative Program. Seminars focus on current issues in child welfare practice and policy. Topics vary from semester to semester. Students arrange own transportation for occasional field trips to community agencies. Required for members of the NC Child Welfare Education Collaborative Program.

Typically offered in Fall and Spring

SW 519 Evaluation of a Social Work Intervention (2 credit hours)
Second of three courses in social work research. Evaluating social work practice and health and human services programs within different research paradigms. Prepares students for collecting, analyzing, and reporting qualitative and quantitative data; includes laboratory experience. Restricted to students who have completed all foundation courses in the MSW program.

P: SW 505 & SW 510
Typically offered in Fall only

SW 520 SW Generalist Practice I (3 credit hours)
Provides the foundation knowledge and skills needed to engage and assess individuals, families and groups. Examines underlying theories and models of research-informed practice and evidence-based social work interventions with particular emphasis on the ecological systems model from a strengths perspective. Presents the phases and dynamics of change in interpersonal helping relationships within a framework of human rights, social justice, and diversity. Restricted to students admitted to the MSW program.

C: SW 505 and SW 651
Typically offered in Fall only

SW 521 SW General Practice II (3 credit hours)
Prepares students for Social Work practice within organizations, communities and policy structures. Emphasizes multiculturalism, diversity, and social justice in relation to social systems. Restricted to students admitted to the MSW program.

P: SW 505 & SW 520; C: SW 652
Typically offered in Spring only

SW 523/SW 423 Social Work with Soldiers, Veterans, and Their Families (3 credit hours)
A basic overview of military life and the issues and challenges faced by military personnel, their families, friends, and community. The course provides a foundational guide to help professionals working with military families and to understand and address these issues and challenges.

R: Junior or Senior standing. Sophomores and Non-Degree may enroll with instructor approval.
Typically offered in Fall and Spring

SW 524 Portrayals of Social Welfare in Urban Life (3 credit hours)
This course provides an in-depth analysis of social policy development in the urban context and the multi-dimensional nature of environments, communities, and individuals. Popular media (newspaper and journal articles, film, television, and textbooks) will proxy as a microcosm of contemporary social welfare problems and purported solutions. Following an ethical and social justice paradigm, this course will examine the portrayals of the urban experience and the attendant social problems of life (crime, drugs, economic bifurcation, educational system, and the media) in an economically depressed or struggling major metropolitan area.

Typically offered in Fall, Spring, and Summer

SW 525/SW 425 Hunger and Homelessness (3 credit hours)
This course will familiarize students with the history and experience of hunger and homelessness in contemporary American society. The course includes discussion, narrative readings, experiential exercises, movie reviews, field trips, and other media to expose students to issues of food insecurity and housing instability. Students will critique ideas of what it means to be "poor" and be exposed to the lives of individuals who do not have access to adequate food, housing, healthcare, and other basic needs. American social welfare policy, including governmental and local programs that address these issues, will be discussed. Students are responsible for transportation.

Restricted: Junior or Senior Standing. Sophomores and Non-Degree Students may enroll with instructor approval.
GEP U.S. Diversity
Typically offered in Fall and Spring

SW 526 DSM and Clinical Conditions (3 credit hours)
This course examines evidence-based treatments across the lifespan from a social work perspective, with a specific focus on the most common mental disorders and evidence-based treatments. Students will demonstrate application of the most current version of the Diagnostic and Statistical Manual of Mental Disorders and become critical consumers of evidence-based treatment research with diverse populations. The course emphasizes strengths and ecological systems perspectives, risk and resiliency factors, and the impact of biological, psychological, cultural, spiritual and other social factors.

Prerequisite: SW 501 and SW 505 and SW 506 and SW 510 and SW 520 and SW 521 and SW 651 and SW 652; Corequisite: SW 653
Typically offered in Fall, Spring, and Summer

SW 540/SW 440 International Learning Experience in Social Work (6 credit hours)
A seven week learning experience in Guatemala. Through this course, the student will develop a global perspective of social welfare and social work practice, will learn about the people and culture of the Lake Atitlan area of Guatemala, will learn the variety of resources available in response to social need, and will enhance or develop Spanish language competence. All costs associated with learning opportunities and activities for this course are included in the cost of the program.

GEP Global Knowledge
Typically offered in Summer only

SW 550 Advanced Social Work Practice with Families (3 credit hours)
Theories, concepts, and skills needed for practice with diverse, at-risk family populations. Includes overview of historical and current social work approaches to family intervention as well as skill development in contemporary intervention methods. Focuses on understanding families within their cultural and community contexts, and presents several family intervention models useful for helping families build on their strengths to cope with a variety of family constellations, changes, and challenges.

Prerequisite: SW 652, Corequisite: SW 654
Typically offered in Spring only

SW 551 Social Work Practice with Children and Adolescents (3 credit hours)
Focuses on assessment and intervention strategies for clinical practice with children and adolescents. Explores issues common to these client groups.

Prerequisite: SW 521 and SW 652
Typically offered in Fall only

SW 557 SW Program Development and Grant Writing (3 credit hours)
This course provides a comprehensive introduction to program development and grant writing in social work. The course examines the major steps in the process including problem identification, needs assessment, program planning, and resource identification and development. It is designed to provide a hands-on approach to developing grant writing and other resource development skills. Restricted to students who have completed all foundation courses in a related graduate program.

Typically offered in Spring only

SW 560 Advanced Policy Practice with Organizations and Communities (3 credit hours)
This is the first course on social policy and examines how social workers collaborate with organizations and communities to intervene in social policy. Strategies for policy practice include values clarification, legislative advocacy, analytic advocacy, and implementation advocacy, and these strategies build upon concepts and skills from community development, social planning, and community organizing. Emphasis is given to working with economically disadvantaged and historically disempowered communities. This course is restricted to students admitted to the MSW Program.

Prerequisite: SW 501 & SW 521
Typically offered in Spring and Summer

SW 561 Social Work Administration and Supervision (3 credit hours)
This course addresses the theoretical frameworks and functions for managing human service organizations. The course will also explore personal and professional values and ethical dilemmas in exercising leadership in the management of culturally diverse community groups, boards, and committee meetings. Issues of staff development, team building, group decision-making, problem solving strategies, legal structure and governance, funding, accountability systems, and human resources will be discussed. The course provides students with a conceptual framework for understanding the management function, and promotes the development of specific skills necessary to critically evaluate and purposefully select among different management strategies.

Prerequisite: SW 521 & SW 652
Typically offered in Fall and Summer

SW 571 Community Mental Health (3 credit hours)
Focuses on social work practice in the field of Mental Health. Reviews policy and practice as it pertains to the promotion of mental health, the prevention of mental illnesses, and the delivery of psychosocial treatment. Strategies and practice for use at the individual, family, group, organizational, community, and societel levels are explored. Master of social work required.

Prerequisite: SW 691

SW 580 Social Work Professional Seminar (4 credit hours)
Capstone course taken in the final semester of the MSW program intended to help students integrate all coursework in preparation for graduation and professional practice. Directs students to apply promising practices to their professional work andencourages students to interact and blend perspectives from both direct practice and community partnership concentration options.

Prerequisite: SW 653

SW 581 Advanced Social Work Practice with Individuals (3 credit hours)
Prepares the student for advanced generalist practice with individuals who are experiencing a range of complex life challenges. Focus on traditional and emerging social work practice theories used by social workers to assist individuals in experiencing external and/or internal stressors. Interventions with diverse populations risk. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 521 and SW 652
Typically offered in Fall only

SW 582 Advanced Social Work Practices with Groups (3 credit hours)
Focuses on advanced social work practice with groups. Uses ecological systems and empowerment perspectives to explore major theories of social work practice with groups. Critical examination of contemporary issues in designing and evaluation group interventions in assessing their impact on individual and social change. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 521 and SW 652; Corequisite: SW 653
Typically offered in Fall only

SW 583 Advanced Social Work Practice with Family Systems (3 credit hours)
Theories, concepts, and skills needed for practice with diverse, at-risk families. Overview of historical and current social work approaches to family intervention as well as skill development in contemporary methods. Focuses on understanding families within their cultural and community contexts and presents several family intervention models useful for helping families build on their strengths to cope with a variety of family constellations, changes, and challenges experienced throughout their lifespan. Restricted to students who have completed all foundation courses in the MSW program.

Prerequisite: SW 521 and SW 652; Corequisite: SW 654
Typically offered in Spring only

SW 590 Social Work Capstone (2 credit hours)
This course involves implementation of a capstone project reflecting mastery of curricular content and demonstrating readiness to practice as an MSW-level professional social worker. Through the capstone project, students apply social work skills and integrate multiple social work concepts, such as the ecological systems and empowerment perspectives, intersectionality, and covert and overt oppression.

P: SW 519
Typically offered in Spring only

SW 595 Special Topics in Social Work (3-6 credit hours)
In-depth exploration of specialized or emerging topics in social work or social welfare. Topic of current interest and mode of study determined by faculty member. Also used to test and develop new courses.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

SW 630 Independent Study in Social Work (1-3 credit hours)
An independent study addressing an area of social work practice or social welfare.

Prerequisite: Master of Social Work, SW 510
Typically offered in Fall, Spring, and Summer

SW 651 Social Work Field Internship I (5 credit hours)
First course in a two-course foundation sequence that provides students the opportunity to use generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

C: SW 505 & SW 520
Typically offered in Fall only

SW 652 Social Work Field Internship II (5 credit hours)
Second course in a two-course foundation field internship sequence that provides students the opportunity to use generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

Prerequisite: SW 520 and SW 651, Corequisite: SW 521
Typically offered in Spring only

SW 653 Advanced Social Work Field Internship I (5 credit hours)
First course in the advanced field internship sequence that provides students with the opportunity to use advanced generalist practice social work in a field agency under the supervision of an MSW social work practitioner.

C: SW 512 or 557 or 561 or 581 or 582
Typically offered in Fall only

SW 654 Advanced Social Work Field Internship II (5 credit hours)
Second course in the advanced field internship sequence that provides students the opportunity to use advanced generalist practice social work skills in a field agency under the supervision of an MSW social work practitioner.

Prerequisite: SW 653; Corequisite: SW 560 or SW 561 or SW 583 or SW 590
Typically offered in Spring only

Sociology (SOC)

SOC 202 Principles of Sociology (3 credit hours)
Introduction to sociology. Analyses of key processes and institutions including interaction, inequality, organization, socialization, and social change. Addresses experiences and outcomes of diverse groups in U.S. society. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203/SOC 203A Current Social Problems (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203A/SOC 203 Current Social Problems (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 204/WGS 204 Sociology of Family (3 credit hours)
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 205 Jobs and Work (3 credit hours)
Work experience in terms of intrinsic and extrinsic rewards for worker. Work experience as intersection of occupation, industry, organization, region, and time period. Research skills for comparing job options to individual goals. Includes core sociological theories, concepts and methods.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 206 Social Deviance (3 credit hours)
Social processes in the creation and maintenance of deviant populations: classification, objectification of social meanings, functions of deviant groups and social outcomes of the deviance-ascription process. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 207 Language and Society (3 credit hours)
Introduction to the intersections of language, society and the individual, and the role of language in social interaction, socialization, ideologies, inequality and social change.Â Focus on language variation related to race, class, gender, and other social identities. Includes core sociological and sociolinguistics concepts, methods, theories.

GEP Interdisciplinary Perspectives, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 211 Community and Health (3 credit hours)
Course introduces students to the fields of community sociology and population health. It focuses on how structural characteristics of communities influence health disparities, as well as the sociocultural, economic, political, and environmental determinants of physical and mental health and well-being.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 212 Race in America (3 credit hours)
Introduction to race and racism in the United States. Analysis of the key role that racism has played in US history and how racism has shaped opportunities and outcomes for people living in the US.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 220/GEO 220 Cultural Geography (3 credit hours)
Investigates the world's past and present cultural diversity by studying spatial patterns of population, language, religion, material and non-material culture, technology and livelihoods, communities and settlements and political organization and interaction.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 241/SOC 241A Sociology of Agriculture and Rural Society (3 credit hours)
Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 241A/SOC 241 Sociology of Agriculture and Rural Society (3 credit hours)
Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 261/ANT 261 Technology in Society and Culture (3 credit hours)
Processes of social and cultural change with a focus on role of technological innovation. Cross-cultural emphasis. Workplace changes and societal risks in U.S. and non-U.S. societies associated with technological innovations. Special attention to the role of scientists and engineers in socio-cultural change. Topical case studies apply course concepts and principles. Core sociological and anthropological concepts, methods, theories.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 295 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

SOC 300 Social Research Methods (4 credit hours)
Basic methods of social research, research design, sampling, data collection, measurement, and analysis; the relationship between theory and research. Laboratory exercises on computer applications.

P: SOC 202 ; C: ST 311
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 301 Human Behavior (3 credit hours)
The development of personality as a consequence of social interactions and behavior of individuals in social contexts. Processes of learning, socialization, social perception, organization, stability and change of attitudes, norms, norm-formation and conformity, social roles and role strain, interpersonal attraction, and intergroup and intragroup relations.

P: 3 credits in 200-level SOC
GEP Social Sciences
Typically offered in Fall and Spring

SOC 304/WGS 304 Gender and Society (3 credit hours)
A sociological analysis of women and men in contemporary American society. Perpetuation of and change in gender stratification using sociological concepts, theories, and research. How gender expectations developed and transmitted. Historical data and research on diversity in American society used for analysis of causes and consequences of gender inequality.

P: 3 credits in SOC at the 200-level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 305/AFS 305 Racial and Ethnic Relations (3 credit hours)
Study of the nature of the relationships among racial and ethnic groups in societies around the world but with emphasis on the United States. Explores topics such as inequalities of wealth, power, and status, racism, conflict, and social boundaries among groups. Current trends in intergroup relations are discussed.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 306 Criminology (3 credit hours)
Study of processes whereby behavior is defined as crime and persons are identified as criminals. Includes a sociological investigation of agencies of law enforcement, adjudication, corrections and prevention; patterns of criminal behavior; explanations of variations in criminality with emphasis on sociocultural and sociopsychological theories.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 307 Sociology of Immigration (3 credit hours)
Examination of the links between institutional discrimination of immigrants, racialization of immigrants, criminalization of immigration, identity formation of immigrant groups, and responses of individuals, communities, and institutions to these processes.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

SOC 309/REL 309 Religion and Society (3 credit hours)
Religious beliefs, practices and organizations addressed as social phenomena. Structural functionalism, conflict and subjectivism as theoretical orientations for understanding influences between religion and society. Relationship of religions to family, government, and economy and to social divisions, conflict and change.

P: 3 credits in SOC at the 200 level
GEP Humanities, GEP Social Sciences
Typically offered in Fall and Spring

SOC 311 Community Relationships (3 credit hours)
Institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationships and trends toward comprehensive planning.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 320 Survey Design (3 credit hours)
Focus on principles of designing surveys and developing survey questions common in sociological research. Topics include the survey-response process, the total survey error paradigm, how to conceptualize and measure attitudes and opinions, sensitive topics, nonresponse and satisficing, survey experiments, randomized-response techniques, pretesting, survey layout, and ethical and compliance issues.

Prerequisite: SOC 300 or PSY 230 or PS 371 or SW 300
GEP Social Sciences
Typically offered in Fall only

SOC 342 International Development (3 credit hours)
Sociological explanations of global patterns of development, with an emphasis on how the global political economy has evolved over time and how this contributes to social, economic, and environmental changes. Focus on the Global South in particular. Contemporary issues (such as migration and global food insecurity) will be included.

P: 3 credits in 200-level SOC
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 350 Food and Society (3 credit hours)
Relationships among individuals, groups, and organizations in the production, consumption, and distribution of food. Influences of gender, class, race, and ethnicity. Impacts of laws and regulations, markets, and social movements.

Prerequisite: 3 credits of a 200-level Sociology
GEP Social Sciences
Typically offered in Spring only

SOC 351 Population and Planning (3 credit hours)
Effects of births, deaths, and migration on population size, composition and distribution. Comparisons across U.S. and non-U.S. societies. Socioeconomic and political implications of demographic change. Impact of alternative policies on demographic processes.

Prerequisite: 3 credits in SOC at the 200 level
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 381 Sociology of Medicine (3 credit hours)
Use of theory and empirical studies to understand the social etiology of disease health practices, practitioners, and institutions, and the special area of mental health. Historical as well as contemporary examples of social influences on, and effects of, health throughout the world, but especially in the United States. Core sociological concepts, methods, theories.

Prerequisite: 200 level Sociology
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

SOC 395 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis. This course is repeatable innumerable times as long as a different topic is addressed each time.

Prerequisite: 3 credits of a 200-level Sociology
Typically offered in Fall, Spring, and Summer

SOC 400 Theories of Social Structure (3 credit hours)
Contributions of Durkheim, Marx, Weber and others to contemporary macro-level sociological theories. Origins and development of functionalist and conflict approaches. Theories of social solidarity, class structure, the state, bureaucratization, ideology. Uses of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall and Spring

SOC 401 Theories of Social Interaction (3 credit hours)
Contributions of Weber, Simmel, Mead, Homans, Goffman and others to contemporary micro-level sociological theories. Origins and development of symbolic interaction, ethnomethodology, exchange theory and dramaturgy. Theories of the self, social construction of reality, emotions, interpersonal relationships. Interrelationship of theory and research; use of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall, Spring, and Summer

SOC 402 Urban Sociology (3 credit hours)
Urban social structures emphasizing determinants and consequences of changes in urban places and life styles. Current urban problems and various approaches to urban social planning.

Prerequisite: SOC 300

SOC 404 Families and Work (3 credit hours)
Sociological analysis of the interplay between economy and family. How men and women make decisions regarding work and family. Theory and research techniques appropriate to the student of work/family conflicts.

Prerequisite: SOC 200 level, SOC 300
Typically offered in Spring only

SOC 405 Racism in the U.S. (3 credit hours)
The course will examine the nature of racism in American society and its correlates: prejudice, discrimination, racial conflict, and racial oppression. Emphasis on the history and development of racism in the U.S. as well as its impact on minority groups. Sociological explanations for the emergence and continuation of racism.

Prerequisite: SOC 300

SOC 407/WGS 407 Sociology of Sexualities (3 credit hours)
Exploration of sexuality in a social context. Relationship between sexuality, gender and power in the U.S. Historical trends in behaviors and identities: social movements and sexual issues; current behavioral trends. Some issues covered; identity, social construction, sexual meanings.

Prerequisite: 3 hours SOC 200 level, 300 level
Typically offered in Fall only

SOC 410 Sociology of Organizations (3 credit hours)
Application of sociological theories to study of organizational structures and processes. Special attention to control and coordination, relations with other organizations, and decision making.

Prerequisite: 3 cr. in SOC, 200 level, SOC 300

SOC 413 Criminal Justice Field Work (4 credit hours)
Supervised observation and experience in a criminal justice agency. Study of relationships between ongoing programs and relevant political and sociological theory and research. Weekly seminars, small groups and individual conferences. Presentation of an integrative report.

Prerequisite: SOC 306 and PS 305, Senior standing in Criminal Justice option
Typically offered in Fall, Spring, and Summer

SOC 414 Social Class (3 credit hours)
The universality of social inequality, its bases and consequences. Relationship of social inequality to social class, life chances, life styles and social mobility. Theories and research methods pertinent to the study of social class.

Prerequisite: SOC 300

SOC 418 Sociology of Education (3 credit hours)
Application of sociological theories to education, relating processes of stratification, socialization and organization. Sociological analysis of classrooms and learning. Connections of schooling with family, community and work. Cross-cultural and U.S. research.

Prerequisite: SOC 300
Typically offered in Fall only

SOC 425 Juvenile Delinquency (3 credit hours)
Nature and extent of juvenile delinquency; measurement problems; and biogenic, psychogenic and sociogenic theories of delinquency causation. Policy implications of delinquency theories for treatment and prevention. Evaluation of treatment and prevention programs.

Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall and Spring

SOC 427 Sociology of Law (3 credit hours)
Sociological concepts, theories and research of law as social control. Social forces behind the creation, maintenance and application of law in American Society.

Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall only

SOC 428 Formal Institutions of Social Control (3 credit hours)
Development, structure and behavior of formal institutions of social control in the United States (police, courts, corrections); divergent philosophies of punishment that guide the juvenile and adult criminal justice system, dimensions of inequalitythat influence processing decisions and effectiveness of formal institutions in controlling violations of legal norms.

Prerequisite: 3 hours SOC 200 level; SOC 300
Typically offered in Spring only

SOC 429 Quantitative Data Analysis in Sociology (3 credit hours)
Analysis of quantitative data in sociology, including relationship between theory and research, operationalization and measurement of concepts, descriptive and inferential statistics using computer statistical software, interpreting statistical findings and writing research papers. Sociology and Criminology majors or consent of the instructor.

Prerequisite: SOC 300 or ST 311 or equivalent
Typically offered in Spring only

SOC 430 Community and Crime (3 credit hours)
Neighborhood development, structure and processes as related to delinquency, crime and criminality. Divergent theories of the effect of neighborhood context on crime and crime on neighborhood processes. The interaction of person and neighborhood context. Implications of community processes for social control.

Prerequisite: 3 credits in SOC 200 level; SOC 300
Typically offered in Spring only

SOC 432/PS 432 Violence, Terrorism, and Public Policy (3 credit hours)
The course examines interpersonal and group violence in contemporary societies and the causes for its occurrences. Specific forms of violence that will be examined include domestic violence, gangs, homicide, and terrorism, domestically and internationally. Throughout the course students will use data to critically evaluate policies and practices to prevent and control violence and will examine potential solutions to the problems of violence.

Prerequisite: SOC 300 or PS 371
Typically offered in Fall and Spring

SOC 440 Social Change (3 credit hours)
Sources, processes and consequences of social change on macro and micro levels. Applications of classical and contemporary theories to historical and modern examples of social change in international, national, regional, community, and institutionalsettings. Examples of empirical studies and appropriate methodologies for each level of analysis.

Prerequisite: 3 cr. in SOC, 200 level; SOC 300
Typically offered in Spring only

SOC 445 Inequality, Ideology, and Social Justice (3 credit hours)
Systematically addresses the question of why people believe what they do about the legitimacy of inequality; explores the role of self-interest, secular and religious values, considers specific types of ideology such as meritocracy, racism, sexism, colonialism; applies various theories to explain patterns of belief; looks at the role of media and propaganda in shaping beliefs.

Prerequisite: 3 hours of 200-level SOC and SOC 300
Typically offered in Fall only

SOC 450 Environmental Sociology (3 credit hours)
Systematic relations between natural environment and human societies. Dependency on the natural world. Population technology, cultural and economic influences on ecosystems. Development of environmentalism and alternative models for understanding threats and potentials. current environmental issues and considerations of their global contexts.

Prerequisite: 3 hours SOC 200 level, SOC 300
Typically offered in Fall only

SOC 457 Corporate Power in America (3 credit hours)
Examines the nature, distribution, and exercise of power in U.S. society. Emphasizes corporate power and its relationship to government. Topics include membership in the upper class and the power elite, media and shaping of public opinion, the culture of politics, formation of political consciousness, and the emergence of oppositional and reactionary social movements.

Prerequisite: (SOC 202 or SOC 203) and SOC 300
Typically offered in Spring only

SOC 465 Social Aspects of Mental Health (3 credit hours)
A survey of the role of social environment and life experiences in mental health and mental disorder, focusing on the link between social inequality and emotional inequality. Topics include the social construction of mental illness and the classification process, social distribution of mental health, explanations of mental health differences. Special emphasis on adolescent and adult traumas that shape the life course.

Prerequisite: SOC 300
Typically offered in Spring only

SOC 492 External Learning Experience (1-6 credit hours)
A learning experience in sociological research that utilizes facilities and resources which are external to the campus. Students are placed with organizations to apply sociological concepts in planning or conducting a research project. Contact the Sociology & Anthropology undergraduate coordinator to obtain department approval.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

SOC 493 Special Problems in Sociology (1-6 credit hours)
A learning experience in sociological research that utilizes campus facilities and resources. Arrangements must be initiated by the student and approved by the instructor prior to the experience. Contact the Sociology & Anthropology undergraduate coordinator to obtain department approval.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

SOC 495 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for new courses on a trial basis.

SOC 498 Independent Study in Sociology (1-6 credit hours)
A detailed investigation of a topic in sociology. Topic and mode of study determined by the faculty member(s) in consultation with the department head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Six hours SOC above the 200 level
Typically offered in Fall, Spring, and Summer

SOC 508 Social Organization (3 credit hours)
Introduction to study of social structure. Focus on inequality, work, organizations, the economy, the state. Classic writings and their impacts.

Prerequisite: SOC 400 or SOC 701

SOC 509 Population Problems (3 credit hours)
Examination of population growth, rates of change and distribution. Emphasis on functional roles of population, i.e., age, sex, race, residence, occupation, marital status and education. Stress on population dynamics fertility, mortality and migration. Analysis on population policy in relation to national and international goals stressing a world view.

Prerequisite: SOC 202

SOC 514 Developing Societies (3 credit hours)
Definition of major problems posed for development sociology and exploration of social barriers and theoretical solutions for development set forth with regard to newly developing countries. Review of significant past strategies and presentation of main themes in current development schemes. Proposal and discussion of untested strategies for the future. Examination of these problems in their national and international contexts.

Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 533 The Community (3 credit hours)
The community viewed in sociological perspective as a functioning entity. Presentation and application of a method of analysis to eight "dimensions," with emphasis on the unique types of understanding to be derived from measuring each dimension. Finally, analysis of effect of change on community integration and development.

Prerequisite: Six hrs. SOC

SOC 591 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Spring only

SOC 601 Seminar (1-3 credit hours)
Appraisal of current literature; presentation of research papers by students; progress reports on departmental research; review of developing research methods and plans; reports from scientific meetings and conferences; other professional matters. Credits Arranged

Typically offered in Fall only

SOC 610 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 642 Practicum In Sociology (1-6 credit hours)
Opportunity for student under supervision of graduate advisory committee chair and organization/agency supervisor to develop and demonstrate competency in the area of graduate specialization through application of sociological knowledge to practicalproblems facing the organization/ agency.

Prerequisite: Graduate standing in the Master of Sociology program and nine hrs. of SOC at the 500-600 level
Typically offered in Fall, Spring, and Summer

SOC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

SOC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 701 Classical Sociological Theory (3 credit hours)
The interdependence of theory and research in sociology; major theoretical classics in the discipline and how they provide foundations for subsequent developments and for analysis in substantive areas.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 702 Contemporary Sociological Theory (3 credit hours)
Works by major figures representing leading schools of sociological theory in the post-World War II period studied as primary sources. Underlying assumptions made explicit, the structure of the theory, including propositions, examined critically anddiscussion of relationships with other theoretical perspectives.

Prerequisite: SOC 701

SOC 705 Historical Materialism Approaches to Social Theory (3 credit hours)
This sociological theory course will cover the development of Marxist social thought from the 19th century to the present. We will explore themes, arguments, and debates during this era, concentrating on theoretical developments and syntheses in the historical materialist traditions, and explore their relevance and application for sociological research. Issues and topics will be broadly organized around theories of class, gender, race, power, ideology, culture, capitalist development, science, social crises, social change, and social justice.

Typically offered in Spring only

SOC 707 Quantitative Sociological Analysis (3 credit hours)
Introduction to application of common quantitative methodologies in sociology including multiple regression and path analysis. Emphasis on selecting appropriate analytical techniques, model estimation and sociological interpretation of findings.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 708 Advanced Sociological Analysis (3 credit hours)
Examination of advanced analysis techniques adaptable to needs of sociological research. Special attention given to causal analysis, analysis of change and aggregate versus individual level data analyses. Consideration of sociological examples. Attention to emerging issues and techniques.

Prerequisite: SOC 711, ST 507 or ST 711
Typically offered in Fall only

SOC 710 Teaching Sociology (3 credit hours)
The objective of this course is for students to further their skills in teaching sociology. Students will plan an undergraduate course, construct a teaching philosophy, evaluate a variety of teaching techniques, and demonstrate an understanding of teaching as a sociological phenomenon.

Prerequisite: Admission to sociology graduate program
Typically offered in Spring only

SOC 711 Research Methods In Sociology I (3 credit hours)
Issues in philosophy of science, causation, relationship of theory and research. Qualitative, experimental and survey design methodologies.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 712 Advanced Survey Research Methods (3 credit hours)
Advanced survey methodology including research design, sampling, questionnaire development and surveys using the World Wide Web. Designing and executing substantive and methodological studies using surveys to perationalize behavioral and social constructs and to test hypotheses.

Prerequisite: SOC 711 and SOC 707
Typically offered in Spring only

SOC 713 Applied Research (3 credit hours)
Studies research process with emphasis upon its application to action problems. Stress upon development of research design to meet action research needs.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 715 Qualitative Sociological Methods and Analysis (3 credit hours)
Survey of qualitative sociological research methods. Practice in research design and evaluation, multiple forms of data gathering and data analysis. Theoretical and epistemological issues as related to qualitative sociology, with special attentionto ritical and feminist epistemological debates.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 721 Deviant Behavior (3 credit hours)
Topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviant; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviant; social action implications.

Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 722 Social Control (3 credit hours)
Examination of need, functions, utilization and effects of both informal and formal social control mechanisms. Emphasis and critical evaluation of theoretical perspectives on social control and the empirical support for these positions.

Prerequisite: Six hrs. SOC above 200 level or Graduate standing or PBS status

SOC 723 Research On Crime and Deviance (3 credit hours)
Major topics including an examination of conceptual problems and research issues and methods in study of crime and deviance; an assessment of current research on crime causation and deviance processes; an examination of research on social control processes and agencies; and an assessment of social action and evaluative research. A variety of substantive topics dealt with in the context of above topical areas including: delinquency, drug usage, mental illness, obesity, stuttering, suicide, prostitution, homicide and rape.

Prerequisite: SOC 721

SOC 725 Gender and Crime (3 credit hours)
This seminar will provide an overview of the literatures on gender, crime and violence. The course framework and readings emphasize the social structures of gender, social constructions of gender, symbolic meaning systems, and intersections of race, class and gender. We will examine theoretical approaches and empirical research that informs our understanding of the gendered commission of offending.

Typically offered in Fall and Spring

SOC 727 Comparative Societies (3 credit hours)
Sociological analysis of societies around the world with particular reference to North and South America. Special emphasis given to cultural and physical setting, population composition, levels of living, relationship of the people to the land, structure and function of major institutions and forces making for change.

Prerequisite: Six hrs. SOC

SOC 731 Survey of Family Sociology (3 credit hours)
Examination of structural and demographic continuities and changes for American families in general and within major subgroups (e.g., race, ethnicity, social class). Consideration of historical and cross-cultural comparisons. Assessment of the impact of families upon their members and the dynamics of marital and family relationships.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 732 Contemporary Family Theory and Research (3 credit hours)
Emphasis on contemporary research, theory and methodological techniques used by sociologists studying families. Critical examination of where field is now and where it appears to be heading. Primarily for graduate students designing or doing research about families.

Prerequisite: SOC 731

SOC 736 Social Stratification (3 credit hours)
The theoretical background, methodological approaches and analysis of the consequences of systems of stratification. Emphasis on static and dynamic qualities of stratification systems on relations within and between societies. Attention to the integrative and divisive quality of stratification as expressed in life styles, world views, etc.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 737/WGS 737 Sociology Of Gender (3 credit hours)
Theories about the development and maintenance of gender. Historical development of gender stratification. How individuals "do gender" in their daily lives. Contemporary research and substantive readings about gender in public and intimate relationships.

Prerequisite: Graduate student, SOC 736 or 731
Typically offered in Fall only

SOC 738 Race and Ethnic Inequality (3 credit hours)
Theoretical and methodological approaches and critical debates on race. Impact of racial discrimination on inequality. Effects of inequality on community institutions. Formation of attitudes and identities.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 739/WGS 739 Social Psychology Of Inequality (3 credit hours)
The effects of race, class and gender inequality on the formation of group consciousness, self-evaluations, emotions, values, attitudes and beliefs. Attention to interpersonal processes through to reproduction of inequality in everyday life.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 746 Sociological Social Psychology (3 credit hours)
Central issues in sociological social psychology, including formation of the self, effects of social structure on individual development, emergence of ritualized interaction and tension between individual agency and societal constraint. Emphasis on symbolic interactionist and dramaturgical perspectives.

Prerequisite: SOC 401t

SOC 752 Work and Industry (3 credit hours)
Control of economy and workplace. Special attention to economic restructuring, the labor process and recent workplace innovations. Theories include managerialism, bank hegemony and deskilling. Historical studies complement analyses of contemporary settings and issues.

Prerequisite: SOC 400 or SOC 508 or SOC 701

SOC 753 Inequality in Work and the Economy (3 credit hours)
Sociological study of structural inequality in labor markets and workplaces with implications for class, race, gender, and spatial disparities in employment-related outcomes. Special attention is paid to job quality, spatial disparities in employment opportunity, and processes contributing to race and gender disparities in job attainment and rewards.

Prerequisite: SOC 701
Typically offered in Spring only

SOC 754 Economic Sociology (3 credit hours)
Embeddedness of economic action by individuals, firms, and states within a social context. Topics include globalization, restructuring, the informal economy, social capital, spatial organization, labor markets and role of the state.

Prerequisite: SOC 701
Typically offered in Spring only

SOC 755 Global Institutions and Markets (3 credit hours)
This course introduces students to sociological and related perspectives on the dynamics of global production and consumption processes, focusing in particular on how they shape and are shaped by their organizational, political, cultural, and natural environments.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 761 Contemporary Debates in Food & Environment (3 credit hours)
This course will be organized around contemporary debates related to the intersections between food and race, class, and gender inequalities. We will focus largely on recent books on these topics, with attention to both their substantive findings as well as the methods and theory employed.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 762 Sociology of Food Systems (3 credit hours)
This course examines the social relations surrounding the production, distribution, and consumption of food. Sociologists of food display considerable diversity in their theoretical approaches, research methods, and empirical foci. This course will traverse social science research and theorizing to offer an analytic taste on what we eat, how we produce and procure it, who benefits, what we think about it, and how it fits with contemporary social life and institutions.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 763 Environmental Sociology (3 credit hours)
This is a survey course in environmental sociology. We begin with a discussion of the emergence and development of environmental sociology, followed by an overview of theoretical perspectives in the field. We then conduct a survey of topics that have typically been addressed in the area. These topics include: environmental concern and values, environmental health, environmental inequality, environmental movements, technological disasters, and global environmental issues. Throughout the course we survey theoretical concerns as they relate to various topics within the field.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 791 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 810 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

SOC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Sociology (SOC)

SOC 202 Principles of Sociology (3 credit hours)
Introduction to sociology. Analyses of key processes and institutions including interaction, inequality, organization, socialization, and social change. Addresses experiences and outcomes of diverse groups in U.S. society. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203/SOC 203A Current Social Problems (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 203A/SOC 203 Current Social Problems (3 credit hours)
Examination of social problems linked to structures of economic, political, gender and racial inequality; including poverty, disease, racism, sexism, unemployment, psychological distress, educational failure, environmental destruction and violence. Possible solutions viewed from a variety of perspectives. Includes core sociological concepts, methods and theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 204/WGS 204 Sociology of Family (3 credit hours)
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 205 Jobs and Work (3 credit hours)
Work experience in terms of intrinsic and extrinsic rewards for worker. Work experience as intersection of occupation, industry, organization, region, and time period. Research skills for comparing job options to individual goals. Includes core sociological theories, concepts and methods.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 206 Social Deviance (3 credit hours)
Social processes in the creation and maintenance of deviant populations: classification, objectification of social meanings, functions of deviant groups and social outcomes of the deviance-ascription process. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 207 Language and Society (3 credit hours)
Introduction to the intersections of language, society and the individual, and the role of language in social interaction, socialization, ideologies, inequality and social change.Â Focus on language variation related to race, class, gender, and other social identities. Includes core sociological and sociolinguistics concepts, methods, theories.

GEP Interdisciplinary Perspectives, GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 211 Community and Health (3 credit hours)
Course introduces students to the fields of community sociology and population health. It focuses on how structural characteristics of communities influence health disparities, as well as the sociocultural, economic, political, and environmental determinants of physical and mental health and well-being.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

SOC 212 Race in America (3 credit hours)
Introduction to race and racism in the United States. Analysis of the key role that racism has played in US history and how racism has shaped opportunities and outcomes for people living in the US.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 220/GEO 220 Cultural Geography (3 credit hours)
Investigates the world's past and present cultural diversity by studying spatial patterns of population, language, religion, material and non-material culture, technology and livelihoods, communities and settlements and political organization and interaction.

GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 241/SOC 241A Sociology of Agriculture and Rural Society (3 credit hours)
Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 241A/SOC 241 Sociology of Agriculture and Rural Society (3 credit hours)
Application of sociological concepts, methods, theories and styles of reasoning to major social problems facing rural America. Changing structure of agriculture; social impact of agricultural technology; rural community growth and decline; rural industrialization, rural poverty, natural resources and environmental issues in rural America. Includes core sociological concepts, methods, theories.

GEP Social Sciences
Typically offered in Fall and Spring

SOC 261/ANT 261 Technology in Society and Culture (3 credit hours)
Processes of social and cultural change with a focus on role of technological innovation. Cross-cultural emphasis. Workplace changes and societal risks in U.S. and non-U.S. societies associated with technological innovations. Special attention to the role of scientists and engineers in socio-cultural change. Topical case studies apply course concepts and principles. Core sociological and anthropological concepts, methods, theories.

GEP Global Knowledge, GEP Interdisciplinary Perspectives, GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 295 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present 200-level subject materials not normally available in regular course offerings or for new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

SOC 300 Social Research Methods (4 credit hours)
Basic methods of social research, research design, sampling, data collection, measurement, and analysis; the relationship between theory and research. Laboratory exercises on computer applications.

P: SOC 202 ; C: ST 311
GEP Social Sciences
Typically offered in Fall, Spring, and Summer

SOC 301 Human Behavior (3 credit hours)
The development of personality as a consequence of social interactions and behavior of individuals in social contexts. Processes of learning, socialization, social perception, organization, stability and change of attitudes, norms, norm-formation and conformity, social roles and role strain, interpersonal attraction, and intergroup and intragroup relations.

P: 3 credits in 200-level SOC
GEP Social Sciences
Typically offered in Fall and Spring

SOC 304/WGS 304 Gender and Society (3 credit hours)
A sociological analysis of women and men in contemporary American society. Perpetuation of and change in gender stratification using sociological concepts, theories, and research. How gender expectations developed and transmitted. Historical data and research on diversity in American society used for analysis of causes and consequences of gender inequality.

P: 3 credits in SOC at the 200-level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 305/AFS 305 Racial and Ethnic Relations (3 credit hours)
Study of the nature of the relationships among racial and ethnic groups in societies around the world but with emphasis on the United States. Explores topics such as inequalities of wealth, power, and status, racism, conflict, and social boundaries among groups. Current trends in intergroup relations are discussed.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

SOC 306 Criminology (3 credit hours)
Study of processes whereby behavior is defined as crime and persons are identified as criminals. Includes a sociological investigation of agencies of law enforcement, adjudication, corrections and prevention; patterns of criminal behavior; explanations of variations in criminality with emphasis on sociocultural and sociopsychological theories.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 307 Sociology of Immigration (3 credit hours)
Examination of the links between institutional discrimination of immigrants, racialization of immigrants, criminalization of immigration, identity formation of immigrant groups, and responses of individuals, communities, and institutions to these processes.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

SOC 309/REL 309 Religion and Society (3 credit hours)
Religious beliefs, practices and organizations addressed as social phenomena. Structural functionalism, conflict and subjectivism as theoretical orientations for understanding influences between religion and society. Relationship of religions to family, government, and economy and to social divisions, conflict and change.

P: 3 credits in SOC at the 200 level
GEP Humanities, GEP Social Sciences
Typically offered in Fall and Spring

SOC 311 Community Relationships (3 credit hours)
Institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationships and trends toward comprehensive planning.

Prerequisite: 3 cr. in SOC, 200 level
GEP Social Sciences
Typically offered in Fall and Spring

SOC 320 Survey Design (3 credit hours)
Focus on principles of designing surveys and developing survey questions common in sociological research. Topics include the survey-response process, the total survey error paradigm, how to conceptualize and measure attitudes and opinions, sensitive topics, nonresponse and satisficing, survey experiments, randomized-response techniques, pretesting, survey layout, and ethical and compliance issues.

Prerequisite: SOC 300 or PSY 230 or PS 371 or SW 300
GEP Social Sciences
Typically offered in Fall only

SOC 342 International Development (3 credit hours)
Sociological explanations of global patterns of development, with an emphasis on how the global political economy has evolved over time and how this contributes to social, economic, and environmental changes. Focus on the Global South in particular. Contemporary issues (such as migration and global food insecurity) will be included.

P: 3 credits in 200-level SOC
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 350 Food and Society (3 credit hours)
Relationships among individuals, groups, and organizations in the production, consumption, and distribution of food. Influences of gender, class, race, and ethnicity. Impacts of laws and regulations, markets, and social movements.

Prerequisite: 3 credits of a 200-level Sociology
GEP Social Sciences
Typically offered in Spring only

SOC 351 Population and Planning (3 credit hours)
Effects of births, deaths, and migration on population size, composition and distribution. Comparisons across U.S. and non-U.S. societies. Socioeconomic and political implications of demographic change. Impact of alternative policies on demographic processes.

Prerequisite: 3 credits in SOC at the 200 level
GEP Global Knowledge, GEP Social Sciences
Typically offered in Fall only

SOC 381 Sociology of Medicine (3 credit hours)
Use of theory and empirical studies to understand the social etiology of disease health practices, practitioners, and institutions, and the special area of mental health. Historical as well as contemporary examples of social influences on, and effects of, health throughout the world, but especially in the United States. Core sociological concepts, methods, theories.

Prerequisite: 200 level Sociology
GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

SOC 395 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present 300-level subject materials not normally available in regular course offerings or for new courses on a trial basis. This course is repeatable innumerable times as long as a different topic is addressed each time.

Prerequisite: 3 credits of a 200-level Sociology
Typically offered in Fall, Spring, and Summer

SOC 400 Theories of Social Structure (3 credit hours)
Contributions of Durkheim, Marx, Weber and others to contemporary macro-level sociological theories. Origins and development of functionalist and conflict approaches. Theories of social solidarity, class structure, the state, bureaucratization, ideology. Uses of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall and Spring

SOC 401 Theories of Social Interaction (3 credit hours)
Contributions of Weber, Simmel, Mead, Homans, Goffman and others to contemporary micro-level sociological theories. Origins and development of symbolic interaction, ethnomethodology, exchange theory and dramaturgy. Theories of the self, social construction of reality, emotions, interpersonal relationships. Interrelationship of theory and research; use of original works.

Prerequisite: 3 cr. in SOC, 200 level
Typically offered in Fall, Spring, and Summer

SOC 402 Urban Sociology (3 credit hours)
Urban social structures emphasizing determinants and consequences of changes in urban places and life styles. Current urban problems and various approaches to urban social planning.

Prerequisite: SOC 300

SOC 404 Families and Work (3 credit hours)
Sociological analysis of the interplay between economy and family. How men and women make decisions regarding work and family. Theory and research techniques appropriate to the student of work/family conflicts.

Prerequisite: SOC 200 level, SOC 300
Typically offered in Spring only

SOC 405 Racism in the U.S. (3 credit hours)
The course will examine the nature of racism in American society and its correlates: prejudice, discrimination, racial conflict, and racial oppression. Emphasis on the history and development of racism in the U.S. as well as its impact on minority groups. Sociological explanations for the emergence and continuation of racism.

Prerequisite: SOC 300

SOC 407/WGS 407 Sociology of Sexualities (3 credit hours)
Exploration of sexuality in a social context. Relationship between sexuality, gender and power in the U.S. Historical trends in behaviors and identities: social movements and sexual issues; current behavioral trends. Some issues covered; identity, social construction, sexual meanings.

Prerequisite: 3 hours SOC 200 level, 300 level
Typically offered in Fall only

SOC 410 Sociology of Organizations (3 credit hours)
Application of sociological theories to study of organizational structures and processes. Special attention to control and coordination, relations with other organizations, and decision making.

Prerequisite: 3 cr. in SOC, 200 level, SOC 300

SOC 413 Criminal Justice Field Work (4 credit hours)
Supervised observation and experience in a criminal justice agency. Study of relationships between ongoing programs and relevant political and sociological theory and research. Weekly seminars, small groups and individual conferences. Presentation of an integrative report.

Prerequisite: SOC 306 and PS 305, Senior standing in Criminal Justice option
Typically offered in Fall, Spring, and Summer

SOC 414 Social Class (3 credit hours)
The universality of social inequality, its bases and consequences. Relationship of social inequality to social class, life chances, life styles and social mobility. Theories and research methods pertinent to the study of social class.

Prerequisite: SOC 300

SOC 418 Sociology of Education (3 credit hours)
Application of sociological theories to education, relating processes of stratification, socialization and organization. Sociological analysis of classrooms and learning. Connections of schooling with family, community and work. Cross-cultural and U.S. research.

Prerequisite: SOC 300
Typically offered in Fall only

SOC 425 Juvenile Delinquency (3 credit hours)
Nature and extent of juvenile delinquency; measurement problems; and biogenic, psychogenic and sociogenic theories of delinquency causation. Policy implications of delinquency theories for treatment and prevention. Evaluation of treatment and prevention programs.

Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall and Spring

SOC 427 Sociology of Law (3 credit hours)
Sociological concepts, theories and research of law as social control. Social forces behind the creation, maintenance and application of law in American Society.

Prerequisite: 3 cr. in SOC 200-level; SOC 300
Typically offered in Fall only

SOC 428 Formal Institutions of Social Control (3 credit hours)
Development, structure and behavior of formal institutions of social control in the United States (police, courts, corrections); divergent philosophies of punishment that guide the juvenile and adult criminal justice system, dimensions of inequalitythat influence processing decisions and effectiveness of formal institutions in controlling violations of legal norms.

Prerequisite: 3 hours SOC 200 level; SOC 300
Typically offered in Spring only

SOC 429 Quantitative Data Analysis in Sociology (3 credit hours)
Analysis of quantitative data in sociology, including relationship between theory and research, operationalization and measurement of concepts, descriptive and inferential statistics using computer statistical software, interpreting statistical findings and writing research papers. Sociology and Criminology majors or consent of the instructor.

Prerequisite: SOC 300 or ST 311 or equivalent
Typically offered in Spring only

SOC 430 Community and Crime (3 credit hours)
Neighborhood development, structure and processes as related to delinquency, crime and criminality. Divergent theories of the effect of neighborhood context on crime and crime on neighborhood processes. The interaction of person and neighborhood context. Implications of community processes for social control.

Prerequisite: 3 credits in SOC 200 level; SOC 300
Typically offered in Spring only

SOC 432/PS 432 Violence, Terrorism, and Public Policy (3 credit hours)
The course examines interpersonal and group violence in contemporary societies and the causes for its occurrences. Specific forms of violence that will be examined include domestic violence, gangs, homicide, and terrorism, domestically and internationally. Throughout the course students will use data to critically evaluate policies and practices to prevent and control violence and will examine potential solutions to the problems of violence.

Prerequisite: SOC 300 or PS 371
Typically offered in Fall and Spring

SOC 440 Social Change (3 credit hours)
Sources, processes and consequences of social change on macro and micro levels. Applications of classical and contemporary theories to historical and modern examples of social change in international, national, regional, community, and institutionalsettings. Examples of empirical studies and appropriate methodologies for each level of analysis.

Prerequisite: 3 cr. in SOC, 200 level; SOC 300
Typically offered in Spring only

SOC 445 Inequality, Ideology, and Social Justice (3 credit hours)
Systematically addresses the question of why people believe what they do about the legitimacy of inequality; explores the role of self-interest, secular and religious values, considers specific types of ideology such as meritocracy, racism, sexism, colonialism; applies various theories to explain patterns of belief; looks at the role of media and propaganda in shaping beliefs.

Prerequisite: 3 hours of 200-level SOC and SOC 300
Typically offered in Fall only

SOC 450 Environmental Sociology (3 credit hours)
Systematic relations between natural environment and human societies. Dependency on the natural world. Population technology, cultural and economic influences on ecosystems. Development of environmentalism and alternative models for understanding threats and potentials. current environmental issues and considerations of their global contexts.

Prerequisite: 3 hours SOC 200 level, SOC 300
Typically offered in Fall only

SOC 457 Corporate Power in America (3 credit hours)
Examines the nature, distribution, and exercise of power in U.S. society. Emphasizes corporate power and its relationship to government. Topics include membership in the upper class and the power elite, media and shaping of public opinion, the culture of politics, formation of political consciousness, and the emergence of oppositional and reactionary social movements.

Prerequisite: (SOC 202 or SOC 203) and SOC 300
Typically offered in Spring only

SOC 465 Social Aspects of Mental Health (3 credit hours)
A survey of the role of social environment and life experiences in mental health and mental disorder, focusing on the link between social inequality and emotional inequality. Topics include the social construction of mental illness and the classification process, social distribution of mental health, explanations of mental health differences. Special emphasis on adolescent and adult traumas that shape the life course.

Prerequisite: SOC 300
Typically offered in Spring only

SOC 492 External Learning Experience (1-6 credit hours)
A learning experience in sociological research that utilizes facilities and resources which are external to the campus. Students are placed with organizations to apply sociological concepts in planning or conducting a research project. Contact the Sociology & Anthropology undergraduate coordinator to obtain department approval.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

SOC 493 Special Problems in Sociology (1-6 credit hours)
A learning experience in sociological research that utilizes campus facilities and resources. Arrangements must be initiated by the student and approved by the instructor prior to the experience. Contact the Sociology & Anthropology undergraduate coordinator to obtain department approval.

Prerequisite: Sophomore standing
Typically offered in Fall, Spring, and Summer

SOC 495 Special Topics in Sociology (1-3 credit hours)
Offered as needed to present materials not normally available in regular course offerings or for new courses on a trial basis.

SOC 498 Independent Study in Sociology (1-6 credit hours)
A detailed investigation of a topic in sociology. Topic and mode of study determined by the faculty member(s) in consultation with the department head. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Six hours SOC above the 200 level
Typically offered in Fall, Spring, and Summer

SOC 508 Social Organization (3 credit hours)
Introduction to study of social structure. Focus on inequality, work, organizations, the economy, the state. Classic writings and their impacts.

Prerequisite: SOC 400 or SOC 701

SOC 509 Population Problems (3 credit hours)
Examination of population growth, rates of change and distribution. Emphasis on functional roles of population, i.e., age, sex, race, residence, occupation, marital status and education. Stress on population dynamics fertility, mortality and migration. Analysis on population policy in relation to national and international goals stressing a world view.

Prerequisite: SOC 202

SOC 514 Developing Societies (3 credit hours)
Definition of major problems posed for development sociology and exploration of social barriers and theoretical solutions for development set forth with regard to newly developing countries. Review of significant past strategies and presentation of main themes in current development schemes. Proposal and discussion of untested strategies for the future. Examination of these problems in their national and international contexts.

Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 533 The Community (3 credit hours)
The community viewed in sociological perspective as a functioning entity. Presentation and application of a method of analysis to eight "dimensions," with emphasis on the unique types of understanding to be derived from measuring each dimension. Finally, analysis of effect of change on community integration and development.

Prerequisite: Six hrs. SOC

SOC 591 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Spring only

SOC 601 Seminar (1-3 credit hours)
Appraisal of current literature; presentation of research papers by students; progress reports on departmental research; review of developing research methods and plans; reports from scientific meetings and conferences; other professional matters. Credits Arranged

Typically offered in Fall only

SOC 610 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 642 Practicum In Sociology (1-6 credit hours)
Opportunity for student under supervision of graduate advisory committee chair and organization/agency supervisor to develop and demonstrate competency in the area of graduate specialization through application of sociological knowledge to practicalproblems facing the organization/ agency.

Prerequisite: Graduate standing in the Master of Sociology program and nine hrs. of SOC at the 500-600 level
Typically offered in Fall, Spring, and Summer

SOC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

SOC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SOC 701 Classical Sociological Theory (3 credit hours)
The interdependence of theory and research in sociology; major theoretical classics in the discipline and how they provide foundations for subsequent developments and for analysis in substantive areas.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 702 Contemporary Sociological Theory (3 credit hours)
Works by major figures representing leading schools of sociological theory in the post-World War II period studied as primary sources. Underlying assumptions made explicit, the structure of the theory, including propositions, examined critically anddiscussion of relationships with other theoretical perspectives.

Prerequisite: SOC 701

SOC 705 Historical Materialism Approaches to Social Theory (3 credit hours)
This sociological theory course will cover the development of Marxist social thought from the 19th century to the present. We will explore themes, arguments, and debates during this era, concentrating on theoretical developments and syntheses in the historical materialist traditions, and explore their relevance and application for sociological research. Issues and topics will be broadly organized around theories of class, gender, race, power, ideology, culture, capitalist development, science, social crises, social change, and social justice.

Typically offered in Spring only

SOC 707 Quantitative Sociological Analysis (3 credit hours)
Introduction to application of common quantitative methodologies in sociology including multiple regression and path analysis. Emphasis on selecting appropriate analytical techniques, model estimation and sociological interpretation of findings.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 708 Advanced Sociological Analysis (3 credit hours)
Examination of advanced analysis techniques adaptable to needs of sociological research. Special attention given to causal analysis, analysis of change and aggregate versus individual level data analyses. Consideration of sociological examples. Attention to emerging issues and techniques.

Prerequisite: SOC 711, ST 507 or ST 711
Typically offered in Fall only

SOC 710 Teaching Sociology (3 credit hours)
The objective of this course is for students to further their skills in teaching sociology. Students will plan an undergraduate course, construct a teaching philosophy, evaluate a variety of teaching techniques, and demonstrate an understanding of teaching as a sociological phenomenon.

Prerequisite: Admission to sociology graduate program
Typically offered in Spring only

SOC 711 Research Methods In Sociology I (3 credit hours)
Issues in philosophy of science, causation, relationship of theory and research. Qualitative, experimental and survey design methodologies.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 712 Advanced Survey Research Methods (3 credit hours)
Advanced survey methodology including research design, sampling, questionnaire development and surveys using the World Wide Web. Designing and executing substantive and methodological studies using surveys to perationalize behavioral and social constructs and to test hypotheses.

Prerequisite: SOC 711 and SOC 707
Typically offered in Spring only

SOC 713 Applied Research (3 credit hours)
Studies research process with emphasis upon its application to action problems. Stress upon development of research design to meet action research needs.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 715 Qualitative Sociological Methods and Analysis (3 credit hours)
Survey of qualitative sociological research methods. Practice in research design and evaluation, multiple forms of data gathering and data analysis. Theoretical and epistemological issues as related to qualitative sociology, with special attentionto ritical and feminist epistemological debates.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 721 Deviant Behavior (3 credit hours)
Topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviant; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviant; social action implications.

Prerequisite: Six hrs. SOC or ANT or Graduate standing or PBS status

SOC 722 Social Control (3 credit hours)
Examination of need, functions, utilization and effects of both informal and formal social control mechanisms. Emphasis and critical evaluation of theoretical perspectives on social control and the empirical support for these positions.

Prerequisite: Six hrs. SOC above 200 level or Graduate standing or PBS status

SOC 723 Research On Crime and Deviance (3 credit hours)
Major topics including an examination of conceptual problems and research issues and methods in study of crime and deviance; an assessment of current research on crime causation and deviance processes; an examination of research on social control processes and agencies; and an assessment of social action and evaluative research. A variety of substantive topics dealt with in the context of above topical areas including: delinquency, drug usage, mental illness, obesity, stuttering, suicide, prostitution, homicide and rape.

Prerequisite: SOC 721

SOC 725 Gender and Crime (3 credit hours)
This seminar will provide an overview of the literatures on gender, crime and violence. The course framework and readings emphasize the social structures of gender, social constructions of gender, symbolic meaning systems, and intersections of race, class and gender. We will examine theoretical approaches and empirical research that informs our understanding of the gendered commission of offending.

Typically offered in Fall and Spring

SOC 727 Comparative Societies (3 credit hours)
Sociological analysis of societies around the world with particular reference to North and South America. Special emphasis given to cultural and physical setting, population composition, levels of living, relationship of the people to the land, structure and function of major institutions and forces making for change.

Prerequisite: Six hrs. SOC

SOC 731 Survey of Family Sociology (3 credit hours)
Examination of structural and demographic continuities and changes for American families in general and within major subgroups (e.g., race, ethnicity, social class). Consideration of historical and cross-cultural comparisons. Assessment of the impact of families upon their members and the dynamics of marital and family relationships.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 732 Contemporary Family Theory and Research (3 credit hours)
Emphasis on contemporary research, theory and methodological techniques used by sociologists studying families. Critical examination of where field is now and where it appears to be heading. Primarily for graduate students designing or doing research about families.

Prerequisite: SOC 731

SOC 736 Social Stratification (3 credit hours)
The theoretical background, methodological approaches and analysis of the consequences of systems of stratification. Emphasis on static and dynamic qualities of stratification systems on relations within and between societies. Attention to the integrative and divisive quality of stratification as expressed in life styles, world views, etc.

Requisite: Admission to SOC Graduate Program
Typically offered in Fall only

SOC 737/WGS 737 Sociology Of Gender (3 credit hours)
Theories about the development and maintenance of gender. Historical development of gender stratification. How individuals "do gender" in their daily lives. Contemporary research and substantive readings about gender in public and intimate relationships.

Prerequisite: Graduate student, SOC 736 or 731
Typically offered in Fall only

SOC 738 Race and Ethnic Inequality (3 credit hours)
Theoretical and methodological approaches and critical debates on race. Impact of racial discrimination on inequality. Effects of inequality on community institutions. Formation of attitudes and identities.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 739/WGS 739 Social Psychology Of Inequality (3 credit hours)
The effects of race, class and gender inequality on the formation of group consciousness, self-evaluations, emotions, values, attitudes and beliefs. Attention to interpersonal processes through to reproduction of inequality in everyday life.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

SOC 746 Sociological Social Psychology (3 credit hours)
Central issues in sociological social psychology, including formation of the self, effects of social structure on individual development, emergence of ritualized interaction and tension between individual agency and societal constraint. Emphasis on symbolic interactionist and dramaturgical perspectives.

Prerequisite: SOC 401t

SOC 752 Work and Industry (3 credit hours)
Control of economy and workplace. Special attention to economic restructuring, the labor process and recent workplace innovations. Theories include managerialism, bank hegemony and deskilling. Historical studies complement analyses of contemporary settings and issues.

Prerequisite: SOC 400 or SOC 508 or SOC 701

SOC 753 Inequality in Work and the Economy (3 credit hours)
Sociological study of structural inequality in labor markets and workplaces with implications for class, race, gender, and spatial disparities in employment-related outcomes. Special attention is paid to job quality, spatial disparities in employment opportunity, and processes contributing to race and gender disparities in job attainment and rewards.

Prerequisite: SOC 701
Typically offered in Spring only

SOC 754 Economic Sociology (3 credit hours)
Embeddedness of economic action by individuals, firms, and states within a social context. Topics include globalization, restructuring, the informal economy, social capital, spatial organization, labor markets and role of the state.

Prerequisite: SOC 701
Typically offered in Spring only

SOC 755 Global Institutions and Markets (3 credit hours)
This course introduces students to sociological and related perspectives on the dynamics of global production and consumption processes, focusing in particular on how they shape and are shaped by their organizational, political, cultural, and natural environments.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 761 Contemporary Debates in Food & Environment (3 credit hours)
This course will be organized around contemporary debates related to the intersections between food and race, class, and gender inequalities. We will focus largely on recent books on these topics, with attention to both their substantive findings as well as the methods and theory employed.

Prerequisite: Graduate standing
Typically offered in Spring only

SOC 762 Sociology of Food Systems (3 credit hours)
This course examines the social relations surrounding the production, distribution, and consumption of food. Sociologists of food display considerable diversity in their theoretical approaches, research methods, and empirical foci. This course will traverse social science research and theorizing to offer an analytic taste on what we eat, how we produce and procure it, who benefits, what we think about it, and how it fits with contemporary social life and institutions.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 763 Environmental Sociology (3 credit hours)
This is a survey course in environmental sociology. We begin with a discussion of the emergence and development of environmental sociology, followed by an overview of theoretical perspectives in the field. We then conduct a survey of topics that have typically been addressed in the area. These topics include: environmental concern and values, environmental health, environmental inequality, environmental movements, technological disasters, and global environmental issues. Throughout the course we survey theoretical concerns as they relate to various topics within the field.

Prerequisite: Graduate standing
Typically offered in Fall only

SOC 791 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 810 Special Topics In Sociology (1-6 credit hours)
An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems.

Typically offered in Fall, Spring, and Summer

SOC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 890 Doctoral Preliminary Exam (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SOC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

SOC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Soil Science (SSC)

SSC 112 Principles of Soil Science (4 credit hours)
Fundamental soil physical and chemical properties and principles. Major lecture topics: soil description, formation, soil water and the hydrologic cycle, and soil fertility and fertilizers. Laboratory exercises in identifying soil horizons, determining soil texture, identifying nutrient deficiency symptoms in plants and interpreting soil fertility test reports. BROOME

Requisite: Agricultural Institute Only
Typically offered in Fall and Spring

SSC 151 Fertilizers and Soil Fertility (3 credit hours)
Principles of managing plant nutrients in soils for crop, turfgrass and other plant production; nutrient requirements; deficiency symptons, nutrient availability in soils; soil acidity and liming; fertilizer materials; organic fertilizers; and environmental effects of fertilizers.

Requisite: Agricultural Institute Only; Prerequisite: SSC 112
Typically offered in Spring only

SSC 185 Land and Life (3 credit hours)
Soil is a fundamental natural resource that sustains life on earth. Detailed information is provided about soils at local, community, regional, national, and global scales; and their importance to world food security and human health, agricultural production, environmental quality, and sustainable ecosystems. Students will gain practical knowledge about soils, their use and management, and their critical role in supporting life. Understanding basic soil properties, their interactions, and how they are influenced or impacted by human activity is essential to everyday life and to being a well-informed citizen.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

SSC 200 Soil Science (3 credit hours)
Fundamentals of soils including origin, composition and classification; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships and soil management.

Prerequisite: CH 101 or CH 100
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

SSC 201 Soil Science Laboratory (1 credit hours)
Hands-on laboratory experience in fundamentals of soils including origin, composition and classification; their physical, chemical, and biological properties; significance of these properties to soil-plant relationships, soil management and the environment.

Corequisite: SSC 200
GEP Natural Sciences
Typically offered in Fall and Spring

SSC 332 Environmental Soil Microbiology (3 credit hours)
Analysis of the effects of soil environments on microbial growth. Relationships and significance of microbes to mineral transformations, plant development, and environmental quality. Management of soil microorganisms in different ecosystems.

Prerequisite: BIO 181 and SSC 200
Typically offered in Spring only

SSC 341 Soil Fertility and Nutrient Management (3 credit hours)
The course provides detailed information on plant nutrition, soil fertility, and management of essential plant nutrients and other amendments affecting plant growth and nutrition. The influence of numerous biological, physical, and chemical soil properties on plant nutrient availability will be emphasized. Students will be familiar with contemporary diagnostic tools to assess nutrient availability, and the soil and nutrient management technologies essential for enhancing soil and plant productivity while minimizing the impact of nutrient use on the environment.

Prerequisite: SSC 200
Typically offered in Fall, Spring, and Summer

SSC 342 Soil and Plant Nutrient Analysis (1 credit hours)
The course provides detailed information on (1) the chemical methods utilized in routine soil testing and plant analysis, (2) field soil sampling techniques, (3) nutrient recommendations, (4) nutrient response functions, and (5) nutrient management planning. Students gain essential experience in interpreting soil, plant, waste, and water analysis reports, and how these data are used in soil and crop management decisions. Course material will be presented in lecture and laboratory format.

Prerequisite: SSC 341
Typically offered in Fall and Spring

SSC 410 Soil Judging for Land Evaluation (1 credit hours)
Lecture and field-based course on describing, classifying, and interpreting soils in their natural setting. Topics will focus on a particular land region that will change each term. The course is in preparation for the regional soil judging contest in the Fall and the national soil judging contest in the Spring. Lectures explain land evaluation techniques and include soil morphology, genesis, and classification. Urban and agricultural applications will be considered. The course meets once per week for 8 weeks. Three field trips will be required and count as field work. The weekly meeting time is TBA. Students who complete the class have the option of participating in a regional, intercollegiate, Soil Judging Contest during each fall semester. Participation in the national contest during the spring semester depends on qualifying at the regional level the previous fall.

Prerequisite: SSC 200
Typically offered in Fall only

SSC 421 Role of Soils in Environmental Management (3 credit hours)
Importance of soils in land application of municipal, industrial and agricultural wastes; onsite disposal of domestic wastewater; bioremediation of contaminated sites; erosion and sedimentation control; farm nutrient management; and nonpoint source water pollution.

Prerequisite: SSC 200
Typically offered in Spring only

SSC 427 Biological Approaches to Sustainable Soil Systems (3 credit hours)
Ecological and biochemical concepts will be applied to managing soils in agro-ecological settings such as organic and conventionally managed farms and gardens, emphasizing microbial transformations of nutrients and matter. Topics covered include soil organic matter formation and fractionation, decomposition, microbial assimilation of nutrients, fertilizer management, tillage, crop rotations, cover crop management. Companion course SSC 428 and SSC 341 recommended.

Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
Typically offered in Fall only

SSC 428/HS 428 Service-Learning in Urban Agriculture Systems (1 credit hours)
Course provides students a hands-on experience in urban agriculture with under-served youth in the Raleigh area. Students partner with a community gardening organization to provide knowledge and experience in soil science and agriculture to youth with the goals of increasing urban food security and developing student leadership skills. Particular emphasis is places on reflecting on course activities and deepening of skills related to extension, outreach, and working with diverse populations. Course designed to be taken as a companion course to SSC 427, however can be taken as a stand-alone course.

Prerequisite: SSC 200 or equivalent, BIO 181 or 183, and CH 101
GEP U.S. Diversity
Typically offered in Spring only

SSC 440/SSC 540 Geographic Information Systems (GIS) in Soil Science and Agriculture (3 credit hours)
Geographic information systems (GIS), global positioning system (GPS), and remote sensing to manage spatially variable soils, vegetation, other natural resources. Develop: function understanding of GIS principles, working knowledge of ArcGIS, problem-solving/critical-thinking necessary to use GIS to characterize and manage soils, agriculture, natural resources. Introduction to GIS; Maps/Cartography; Vectore/Raster Data Models; Georeferencing/Coordinate Systems; Spatial Data Sources; GPS/GPS skillls/ Remote Sensing; Statistics/Interpolation; Precision Agriculture; Computer Aided Design and GIS; Creating Analyzing 3-D Surfaces. Credit not given for both SSC 440 and SSC 540.

Prerequisite: SSC 200
Typically offered in Fall and Spring

SSC 442 Soil and Environmental Biogeochemistry (3 credit hours)
Quantitative approaches to the cycling of elements and chemical species in soils and the environment, including carbon and organic contaminants, non-metallic macronutrients, metals and metalloids.

Prerequisite: SSC 200 and (CH 101, or CH 201, or CH 220, or CH 221)
Typically offered in Spring only

SSC 452 Soil Classification (4 credit hours)
Genesis, morphology, and classification of soils; characterization of soils according to their diagnostic properties; interpreting soil use potential; emphasis on North Carolina soils and their taxonomy; field exercise in soil mapping and site evaluation; several field trips, one overnight.

Prerequisite: SSC 200
Typically offered in Spring only

SSC 455 Soils, Environmental Quality and Global Challenges (3 credit hours)
As the world population grows to 9 billion people by 2050, we will be pressed to increase food security, respond to the consequences of a changing climate, and improve human health -- all while protecting the environment and maintaining natural resources. Soils play a critical role in many of these challenges. The goal of this course is to teach students how soils regulate environmental quality through a host of chemical, physical a,d biological processes. We will examine a series of global challenges, assess their related environmental issues and policies, and analyse the roles of soils in each issue.

P: SSC 200 or ES 100 or Instructor permission
Typically offered in Fall only

SSC 461 Soil Physical Properties and Plant Growth (3 credit hours)
Soil physical properties and their influence on plant growth and environmentally sound land use; soil solid-porosity-density relationships, soil water, heat and air relations and transport. Principles and applications of these topics using current literature in agronomy, turf, horticulture, water quality, waste management and urban land use.

Prerequisite: SSC 200
Typically offered in Fall only

SSC 462 Soil-Crop Management Systems (3 credit hours)
Unites principles of soil science and crop science with those of allied areas into realistic agronomic applications; practical studies in planning and evaluation of soil and crop management systems.

Prerequisite: CS 213 and CS 414 and SSC 342 and Senior standing
Typically offered in Spring only

SSC 470/SSC 570 Wetland Soils (3 credit hours)
Wetland definitions, concepts, functions and regulations; chemical, physical and morphological characteristics of wetland soils. Wetland soil identification using field indicators and monitoring equipment; principles of wetland creation, restoration and mitigation. Special project required for SSC 570. Two mandatory field trips. Field trips for distance education students are not required but optional. Credit will not be given for both SSC 470 and SSC 570.

Prerequisite: SSC 200, SSC 452 recommended
Typically offered in Fall, Spring, and Summer

SSC 473/BAE 473/BAE 573/SSC 573 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.

Prerequisite: BAE 371
Typically offered in Fall only

SSC 511 Soil Physics (4 credit hours)
Soil physical properties and theory of selected instrumentation to measure them. Topics including soil solids, soil water, air and heat. Emphasis on transport processes and the energy concept of soil and water.

Prerequisite: SSC 200, PY 212
Typically offered in Fall only

SSC 521 Soil Chemistry (3 credit hours)
A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays and electrokinetic properties of clay-water systems.

Prerequisite: SSC 200, one yr. of general inorganic chemistry
Typically offered in Spring only

SSC 532/MB 532 Soil Microbiology (4 credit hours)
Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality.

Prerequisite: MB 351, CH 220

SSC 535/CS 535 Root and Rhizosphere Processes for Plant Nutrition (3 credit hours)
The focus of this course is on the understanding of concepts and principles of plant hydro-mineral acquisition, plant adaptation to nutrient deficiencies, water and nutrient cycles in the soil, and the impact that microbial communities have on these processes. Understanding below ground biological networks and their complexity is crucial for understanding soil fertility and improving the acquisition of nutrients in natural and agroecosystems.

Prerequisite: SSC 200 or PB 321, or consent of instructor
Typically offered in Fall only

SSC 540/SSC 440 Geographic Information Systems (GIS) in Soil Science and Agriculture (3 credit hours)
Geographic information systems (GIS), global positioning system (GPS), and remote sensing to manage spatially variable soils, vegetation, other natural resources. Develop: function understanding of GIS principles, working knowledge of ArcGIS, problem-solving/critical-thinking necessary to use GIS to characterize and manage soils, agriculture, natural resources. Introduction to GIS; Maps/Cartography; Vectore/Raster Data Models; Georeferencing/Coordinate Systems; Spatial Data Sources; GPS/GPS skillls/ Remote Sensing; Statistics/Interpolation; Precision Agriculture; Computer Aided Design and GIS; Creating Analyzing 3-D Surfaces. Credit not given for both SSC 440 and SSC 540.

Prerequisite: SSC 200
Typically offered in Spring only

SSC 541 Soil Fertility (3 credit hours)
Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods of measuring nutrient availability.

Prerequisite: SSC 341

SSC 545 Remote Sensing Applications in Soil Science and Agriculture (3 credit hours)
Overview of remote sensing including history, evolution, vocabulary, and physical principles, i.e., electromagnetic radiation and its interaction with matter. Distant and proximate remote sensing techniques (aerial photography, satellite imaging, radar, lidar, etc.), hardware, and platforms and their application in the characterization and management of soils and crops. Development of strategies for incorporating remote sensing into soil and agronomic research, and of practical skills for processing, analysis, display, and discussion of remote sensing data with applications in soil science and agriculture.

Prerequisite: SSC 200, PY 212

SSC 551 Soil Morphology, Genesis and Classification (3 credit hours)
Morphology: Chemical, physical and mineralogical parameters useful in characterizing soil. Genesis: soil-forming factors and processes. Classification: historical development and present concepts of soil taxonomy with particular reference to worldwide distribution of great soil groups as well as discussions of logical bases of soil classification.

Prerequisite: SSC 200

SSC 562 Environmental Applications Of Soil Science (3 credit hours)
Identification and evaluation of basic factors influencing movement of potential pollutants through soil and their underlying strata. Development of understanding of processes of soil and site evaluation for waste disposal and transport of pollutants through soils.

Prerequisite: SSC 200
Typically offered in Spring only

SSC 570/SSC 470 Wetland Soils (3 credit hours)
Wetland definitions, concepts, functions and regulations; chemical, physical and morphological characteristics of wetland soils. Wetland soil identification using field indicators and monitoring equipment; principles of wetland creation, restoration and mitigation. Special project required for SSC 570. Two mandatory field trips. Field trips for distance education students are not required but optional. Credit will not be given for both SSC 470 and SSC 570.

Prerequisite: SSC 200, SSC 452 recommended
Typically offered in Fall, Spring, and Summer

SSC 573/SSC 473/BAE 473/BAE 573 Introduction to Hydrologic and Water Quality Modeling (3 credit hours)
Concepts in basic hydrologic, erosion and chemical transport used in modeling. Evaluation of typical hydrologic and water quality models on watershed systems. Project examples using state-of-the-art models. Credit will not be given for both BAE 473 and BAE 573.

Prerequisite: BAE 371
Typically offered in Fall only

SSC 590 Special Problems in Soil Science (1-6 credit hours)
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits arranged in consultation with sponsoring faculty member.

Prerequisite: SSC 200 or consent of instructor.
Typically offered in Fall, Spring, and Summer

SSC 592 Special Topics in Soil Science (1-6 credit hours)
Special Topics in Soil Science. Topics of contemporary interest in soil science presented in an experimental or pilot course format.

P: Graduate Standing
Typically offered in Fall, Spring, and Summer

SSC 601 Seminar (1 credit hours)
A maximum of two semester hours allowed toward the master's degree, but any number toward the doctorate. Scientific articles, progress reports in research and special problems of interest to soil scientists reviewed and discussed.

Prerequisite: Graduate standing in SSC
Typically offered in Fall and Spring

SSC 609 Colloquium In Soil Science (1-3 credit hours)
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged

Prerequisite: Graduate standing in SSC
Typically offered in Fall and Spring

SSC 620 Special Problems (1-6 credit hours)
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged

Prerequisite: SSC 200
Typically offered in Fall and Spring

SSC 675 Project in Soil Science (1-6 credit hours)
Credit for required, independent project in soil science for the Master of Soil Science degree program. Project topic and learning contract will be developed with, and approved by, the student's faculty advisor and the Director of Graduate Programs. May be repeated for a maximum of 6 credit hours towards the Master of Soil Science degree. May not be taken by Master of Science or PhD students.

R: Master of Soil Science (MR) students only
Typically offered in Fall, Spring, and Summer

SSC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

SSC 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 690 Master's Exam (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam. Credits Arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

SSC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

SSC 720 Soil and Plant Analysis (3 credit hours)
Theory and advanced principles of utilization of chemical instruments to aid research on the heterogeneous systems of soils and plants.

Prerequisite: PY 212; CH 315; at least three soils courses including SSC 341
Typically offered in Spring only

SSC 725/TOX 725/CS 725/HS 725 Pesticide Chemistry (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taughtduring the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Spring only

SSC 727/TOX 727/CS 727/HS 727 Pesticide Behavior and Fate In the Environment (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725,SSC 200
Typically offered in Spring only

SSC 771/BAE 771 Theory Of Drainage--Saturated Flow (3 credit hours)
Discussion of physical concepts and properties of fluids and porous media in relation to soil-water movement. Derivation and discussion of the fundamental laws and equations governing saturated flow in porous media. Analysis of mathematical solutions of steady-state and transient flow equations to determine their applicability to drainage problems. Consideration of analogs and models of particular drainage problems.

Prerequisite: MA 301
Typically offered in Fall only

SSC 790 Special Topics (1-6 credit hours)
The study of special problems and selected topics of current interest in soil science and related fields.

Typically offered in Fall only

SSC 801 Seminar (1 credit hours)
Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

Typically offered in Fall and Spring

SSC 809 Colloquium In Soil Science (1-3 credit hours)
Seminar-type discussions and lectures on specialized and advanced topics in soil science. Credits Arranged

Prerequisite: Graduate standing in SSC
Typically offered in Fall, Spring, and Summer

SSC 820 Special Problems (1-6 credit hours)
Special problems in various phases of soils. Emphasis placed on review of recent and current research. Credits Arranged

Prerequisite: SSC 200
Typically offered in Fall and Spring

SSC 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

SSC 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SSC 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graudate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SSC 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

SSC 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

SSC 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination and residency requirements for the doctoral degree and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Statistics (ST)

ST 101 Statistics by Example (3 credit hours)
Sampling, experimental design, tables and graphs, relationships among variables, probability, estimation, hypothesis testing. Real life examples from the social, physical and life sciences, the humanities and sports. Credit not allowed if student has prior credit for another ST course

GEP Mathematical Sciences
Typically offered in Fall and Spring

ST 114 Statistical Programming (3 credit hours)
This is an introductory course in computer programming for statisticians using Python. Emphasis is on designing algorithms, problem solving, and forming good coding practices: methodical development of programs from specifications; documentation and style; appropriate use of control structures such as loops, of data types such as arrays; modular program organization; version control. Students will become acquainted with core statistical computational problems through examples and coding assignments, including computation of histograms, boxplots, quantiles, and least squares regression.

Restriction: Statistics majors only
Typically offered in Fall only

ST 305 Statistical Methods (4 credit hours)
Basic concepts of data collection, sampling, and experimental design. Descriptive analysis and graphical displays of data. Probability concepts, and expectations. Normal and binomial distributions. Sampling distributions and the Central Limit Theorem. Confidence intervals and hypothesis testing. Tests for means/proportions of two independent groups. One factor analysis of variance. Understanding relationships among variables; correlation and simple linear regression. Computer use is emphasized.

Prerequisite: MA 141; Corequisite: ST 307
Typically offered in Fall and Spring

ST 307 Introduction to Statistical Programming- SAS (1 credit hours)
An introduction to using the SAS statistical programming environment. The course will combine lecture and a virtual computing laboratory to teach students how to use the SAS sytem for: basic data input and manipulation; graphical displays of univariate and bivariate data; one- and two-sample analyses of means; simple linear regression; one-way ANOVA. Documentation of code and writing of statistical reports will be included.

Corequisite: ST 305 or ST 312 or ST 372 or Prerequisite: ST 350 or BUS 350
Typically offered in Fall and Spring

ST 308 Introduction to Statistical Programming - R (1 credit hours)
Introduction to the statistical programming language R. The course will cover: reading and manipulating data; use of common data structures (vectors, matrices, arrays, lists); basic graphical representations.

Typically offered in Spring only

ST 311 Introduction to Statistics (3 credit hours)
Examining relationships between two variables using graphical techniques, simple linear regression and correlation methods. Producing data using experiment design and sampling. Elementary probability and the basic notions of statistical inference including confidence interval estimation and tests of hypothesis. One and two sample t-tests, one-way analysis of variance, inference for count data and regression. Credit not allowed if student has prior credit for another ST course or BUS 350

GEP Mathematical Sciences
Typically offered in Fall, Spring, and Summer

ST 312 Introduction to Statistics II (3 credit hours)
A further examination of statistics and data analysis. Inference for comparing multiple samples, experimental design, analysis of variance and post-hoc tests. Inference for correlation, simple regression, multiple regression, and curvilinear regression. Analysis of contingency tables and categorical data. No credit for students who have credit for ST 305.

Prerequisite: ST 311
GEP Mathematical Sciences
Typically offered in Fall and Spring

ST 350/BUS 350 Economics and Business Statistics (3 credit hours)
Introduction to statistics applied to management, accounting, and economic problems. Emphasis on statistical estimation, inference, simple and multiple regression, and analysis of variance. Use of computers to apply statistical methods to problems encountered in management and economics.

Prerequisite: MA 114
Typically offered in Fall, Spring, and Summer

ST 370 Probability and Statistics for Engineers (3 credit hours)
The class is a calculus-based introduction to probability and statistics, with a focus on collection and summary of data, along with making formal inferences and practical conclusions on the basis of data. Topics may include sampling, descriptive statistics, designed experiments, simple and multiple regression, basic probability, discrete and continuous distributions, sampling distributions, hypothesis testing, confidence intervals, one and two-way ANOVA.

Prerequisite: MA 241
Typically offered in Fall, Spring, and Summer

ST 371 Introduction to Probability and Distribution Theory (3 credit hours)
Basic concepts of probability and distribution theory for students in the physical sciences, computer science and engineering. Provides the background necessary to begin study of statistical estimation, inference, regression analysis, and analysis of variance.

Prerequisite: MA 241, Corequisite: MA 242
Typically offered in Fall and Spring

ST 372 Introduction to Statistical Inference and Regression (3 credit hours)
Statistical inference and regression analysis including theory and applications. Point and interval estimation of population parameters. Hypothesis testing including use of t, chi-square and F. Simple linear regression and correlation. Introduction to multiple regression and one-way analysis of variance.

Prerequisite: ST 371
Typically offered in Fall and Spring

ST 380 Probability and Statistics for the Physical Sciences (3 credit hours)
Introduction to probability models and statistics with emphasis on Monte Carlo simulation and graphical display of data on computer laboratory workstations. Statistical methods include point and interval estimation of population parameters and curveand surface fitting (regression analysis). Credit not allowed for both ST 380 and ST 361 or ST 370

Prerequisite: MA 241
Typically offered in Fall only

ST 401 Experiences in Data Analysis (4 credit hours)
This course will allow students to see many practical aspects of data analysis. Each section of this course will expose students to the process of data analysis in a themed area such as biostatistics or environmental statistics. Students will see problems of data collection and analysis through a combination of classroom demonstrations, hands on computer activities and visits to local industries.

Prerequisite: Permission of Instructor and either ST 311 or ST 305
Typically offered in Summer only

ST 404/GPH 404 Epidemiology and Statistics in Global Public Health (3 credit hours)
This course will provide a general introduction to the quantitative methods used in global health, combining elements of epidemiology and biostatistics. The course will focus on linear and logistic regression, survival analysis, traditional study designs, and modern study designs. Students will learn fundamental principles in epidemiology, including statistical approaches, and apply them to topics in global public health. The course prerequisite is a B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or ST 371. In addition, a B- or better in GPH 201 is strongly recommended.

Pre-requisite: B- or better in one of these courses: ST 305, ST 311, ST 350, ST 370, or 371
Typically offered in Fall only

ST 405/ST 505 Applied Nonparametric Statistics (3 credit hours)
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Classical nonparametric hypothesis testing methods, Spearman and Kendall correlation coefficients, permutation tests, bootstrap methods, and nonparametric regressions will be covered.

Prerequisite: ST 508 or ST 512 or ST 514 or ST 516
Typically offered in Fall only

ST 412/MA 412 Long-Term Actuarial Models (3 credit hours)
Long-term probability models for risk management systems. Theory and applications of compound interest, probability distributions of failure time random variables, present value models of future contingent cash flows, applications to insurance, health care, credit risk, environmental risk, consumer behavior and warranties.

Prerequisite: MA 241 or MA 231, Corequisite: MA 421, BUS(ST) 350, ST 301, ST 305, ST 311, ST 361, ST 370, ST 371, ST 380 or equivalent
Typically offered in Fall only

ST 413/MA 413 Short-Term Actuarial Models (3 credit hours)
Short-term probability models for risk management systems. Frequency distributions, loss distributions, the individual risk model, the collective risk model, stochastic process models of solvency requirements, applications to insurance and businessdecisions.

Prerequisite: MA 241 or MA 231, and one of MA 421, ST 301, ST 305, ST 370, ST 371, ST 380, ST 421.
Typically offered in Summer only

ST 421 Introduction to Mathematical Statistics I (3 credit hours)
First of a two-semester sequence of mathematical statistics, primarily for undergraduate majors in Statistics. Introduction to probability, univariate and multivariate probability distributions and their properties, distributions of functions of random variables, random samples and sampling distributions. Credit is not allowed for both ST 421 and MA 421.

Prerequisite: MA 242
Typically offered in Fall and Spring

ST 422 Introduction to Mathematical Statistics II (3 credit hours)
Second of a two-semester sequence of mathematical statistics, primarily for undergraduate majors in Statistics. Random samples, point and interval estimators and their properties, methods of moments, maximum likelihood, tests of hypotheses, elements of nonparametric statistics and elements of general linear model theory.

Prerequisite: ST 421 or MA 421
Typically offered in Fall and Spring

ST 430 Introduction to Regression Analysis (3 credit hours)
Regression analysis as a flexible statistical problem solving methodology. Matrix review; variable selection; prediction; multicolinearity; model diagnostics; dummy variables; logistic and non-linear regression. Emphasizes use of computer.

Prerequisites: (ST 305 or ST 312 or ST 372) and ST 307 and (MA 303 or MA 305 or MA 405)
Typically offered in Fall and Spring

ST 431 Introduction to Experimental Design (3 credit hours)
Experimental design as a method for organizing analysis procedures. Completely randomized, randomized block, factorial, nested, latin squares, split-plot and incomplete block designs. Response surface and covariance adjustment procedures. Stresses use of computer.

Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall, Spring, and Summer

ST 432 Introduction to Survey Sampling (3 credit hours)
Design principles pertaining to planning and execution of a sample survey. Simple random, stratified random, systematic and one- and two-stage cluster sampling designs. Emphasis on statistical considerations in analysis of sample survey data. Class project on design and execution of an actual sample survey.

Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall and Spring

ST 433/ST 533 Applied Spatial Statistics (3 credit hours)
Introduction to statistical models and methods for analyzing various types of spatially referenced data. The focus is on applications with real data and their analysis with statistical programs such as R and SAS. Students are required to write, modify, and run computer code in order to complete homework assignments and final projects.

P: ST 422 and ST 430
Typically offered in Spring only

ST 434/ST 534 Applied Time Series (3 credit hours)
Statistical models and methods for the analysis of time series data using both time domain and frequency domain approaches. A brief review of necessary statistical concepts and R will be given at the beginning. Analyses of real data sets using the statistical software packages will be emphasized.

Prerequisite: ST 422 and ST 430
Typically offered in Fall only

ST 435/ST 535 Statistical Methods for Quality and Productivity Improvement (3 credit hours)
Use of statistics for quality control and productivity improvement. Control chart calculations and graphing, process control and specification; sampling plans; and reliability. Computer use will be stressed for performing calculations and graphing.

Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall only

ST 437/ST 537 Applied Multivariate and Longitudinal Data Analysis (3 credit hours)
An introduction to use of statistical methods for analyzing multivariate and longitudinal data collected in experiments and surveys. Topics covered include multivariate analysis of variance, discriminant analysis, principal components analysis, factor analysis, covariance modeling, and mixed effects models such as growth curves and random coefficient models. Emphasis is on use of a computer to perform statistical analysis of multivariate and longitudinal data.

Prerequisite: ST 422 and ST 430
Typically offered in Fall and Spring

ST 440/ST 540 Applied Bayesian Analysis (3 credit hours)
Introduction to Bayesian concepts of statistical inference; Bayesian learning; Markov chain Monte Carlo methods using existing software (SAS and OpenBUGS); linear and hierarchical models; model selection and diagnostics.

Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 442/CSC 442 Introduction to Data Science (3 credit hours)
Overview of data structures, data lifecycle, statistical inference. Data management, queries, data cleaning, data wrangling. Classification and prediction methods to include linear regression, logistic regression, k-nearest neighbors, classification and regression trees. Association analysis. Clustering methods. Emphasis on analyzing data, use and development of software tools, and comparing methods.

Prerequisite: (MA 305 or MA 405) and (ST 305 or ST 312 or ST 370 or ST 372 or ST 380) and (CSC 111 or CSC 112 or CSC 113 or CSC 114 or CSC 116 or ST 114 or ST 445)
Typically offered in Fall only

ST 445 Introduction to Statistical Computing and Data Management (3 credit hours)
Detailed discussion of the program data vector and data handling techniques that are required to apply statistical methods. Topics are based on the current content of the Base SAS Certification Exam and typically include: importing, validating, and exporting of data files; manipulating, subsetting, and grouping data; merging and appending data sets; basic detail and summary reporting; and code debugging. Additional topics with practical applications, such as graphics and advanced reporting, may also be introduced. Statistical methods for analyzing data are not covered in this course. Regular access to a computer for homework and class exercises is required. Previous exposure to SAS is expected.

Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall and Spring

ST 446 Intermediate SAS Programming with Applications (3 credit hours)
This course covers a wide range of SAS skills that build on the topics introduced in ST 445: Introduction to Statistical Computing and Data Management. In particular, many topics related to the Advanced SAS Certifi cation Exam are covered in order to help students prepare for that exam. However, an additional goal of equal importance is to synthesize statistical content such as regression, distributional assumptions for inference, and power from multiple courses through simulation- and graphics-based investigations.

Prerequisite: ST 430 and ST 445
Typically offered in Spring only

ST 491 Statistics in Practice (3 credit hours)
Mentored experience in applied statistical analysis. Students will work in small groups in collaboration with local scientists to answer real questions about real data. The experience involves mentoring by both the project scientist and the instructor.

P: ST 430
Typically offered in Spring only

ST 495 Special Topics in Statistics (1-6 credit hours)
Offered as needed to present material not normally available in regular departmental course offerings, or for offering new courses on a trial basis.

Typically offered in Fall, Spring, and Summer

ST 497 Professional Experience in Statistics (1-3 credit hours)
Mentored professional experience in statistics. A minimum of 45 hours must be completed for each credit hour earned. The experience must be arranged in advance by the student and approved by the Department of Statistics prior to enrollment. Approval requires completion of the Statistics Department's Experiential Learning Contract, which must be signed by the student, their professional mentor, and their academic advisor. Professional mentors are encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. Students should refer to their curriculum requirements for possible restrictions on the total number of ST 497 credit hours that may be applied to their degree.

Prerequisite: Sophomore Standing. Students are responsible for identifying their own internship mentor and experience.
Typically offered in Fall, Spring, and Summer

ST 498 Independent Study In Statistics (1-6 credit hours)
Detailed investigation of topics of particular interest to advanced undergraduates under faculty direction. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Six hours of ST
Typically offered in Fall, Spring, and Summer

ST 499 Research Experience in Statistics (1-3 credit hours)
Mentored research experience in statistics. A minimum of 45 hours must be completed for each credit hour earned. The experience must be arranged in advance by the student and approved by the Department of Statistics prior to enrollment. Approval requires completion of the Statistics Department's Experiential Learning Contract, which must be signed by the student, their research mentor, and their academic advisor. Research mentors are encouraged to require a research paper or poster presentation as part of the work expectations when appropriate. Students should refer to their curriculum requirements for possible restrictions on the total number of ST 499 credit hours that may be applied to their degree.

Prerequisite: Sophomore Standing. Students are responsible for identifying their own research mentor and experience.
Typically offered in Fall, Spring, and Summer

ST 501 Fundamentals of Statistical Inference I (3 credit hours)
First of a two-semester sequence in probability and statistics taught at a calculus-based level. Probability: discrete and continuous distributions, expected values, transformations of random variables, sampling distributions. Credit not given for both ST 701 and ST 501. Note: this course will be offered in person (Fall) and online (Summer).

Prerequisite: MA 242 or equivalent
Typically offered in Fall and Summer

ST 502 Fundamentals of Statistical Inference II (3 credit hours)
Second of a two-semester sequence in probability and statistics taught at a calculus-based level. Statistical inference: methods of construction and evaluation of estimators, hypothesis tests, and interval estimators, including maximum likelihood. Credit not given for both ST 702 and ST 502. Note: this course will be offered in person (Spring) and online (Fall).

Prerequisite: ST 501
Typically offered in Fall and Spring

ST 503 Fundamentals of Linear Models and Regression (3 credit hours)
Estimation and testing in full and non-full rank linear models. Normal theory distributional properties. Least squares principle and the Gauss-Markov theorem. Estimability, analysis of variance and co variance in a unified manner. Practical model-building in linear regression including residual analysis, regression diagnostics, and variable selection. Emphasis on use of the computer to apply methods with data sets. Credit not given for both ST 705 and ST 503. Note: this course will be offered in person (Spring) and online (Summer).

P: ST 501 and MA 405 or equivalent (Linear Algebra); C: ST 502
Typically offered in Spring and Summer

ST 505/ST 405 Applied Nonparametric Statistics (3 credit hours)
Statistical methods requiring relatively mild assumptions about the form of the population distribution. Classical nonparametric hypothesis testing methods, Spearman and Kendall correlation coefficients, permutation tests, bootstrap methods, and nonparametric regressions will be covered.

Prerequisite: ST 508 or ST 512 or ST 514 or ST 516
Typically offered in Fall only

ST 507 Statistics For the Behavioral Sciences I (3 credit hours)
A general introduction to the use of descriptive and inferential statistics in behavioral science research. Methods for describing and summarizing data presented, followed by procedures for estimating population parameters and testing hypotheses concerning summarized data.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ST 511 Statistical Methods For Researchers I (3 credit hours)
Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square.

Prerequisite: Graduate Standing
Typically offered in Fall, Spring, and Summer

ST 512 Statistical Methods For Researchers II (3 credit hours)
Covariance, multiple regression, curvilinear regression, concepts of experimental design, factorial experiments, confounded factorials, individual degrees of freedom and split-plot experiments. Computing laboratory addressing computational issues and use of statistical software.

Prerequisite: ST 511 or ST 513 or ST 517
Typically offered in Fall, Spring, and Summer

ST 513 Statistics for Management and Social Sciences I (3 credit hours)
This course introduces important ideas about collecting high quality data and summarizing that data appropriately both numerically and graphically. We explore the use of probability distributions to model data and find probabilities. Estimation of parameters and properties of estimators are discussed. Construction and interpretation of commonly used confidence intervals and hypothesis tests are investigated. Students will gain considerable experience working with data. Software is used throughout the course with the expectation of students being able to produce their own analyses.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ST 514 Statistics For Management and Social Sciences II (3 credit hours)
Linear regression, multiple regression and concepts of designed experiments in an integrated approach, principles of the design and analysis of sample surveys, use of computer for analysis of data.

Prerequisite: ST 513
Typically offered in Spring and Summer

ST 515 Experimental Statistics for Engineers I (3 credit hours)
General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance,enumeration data and experimental design.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

ST 516 Experimental Statistics For Engineers II (3 credit hours)
General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data and experimental designs.

Prerequisite: ST 515
Typically offered in Fall and Spring

ST 517 Applied Statistical Methods I (3 credit hours)
Course covers basic methods for summarizing and describing data, accounting for variability in data, and techniques for inference. Topics include basic exploratory data analysis, probability distributions, confidence intervals, hypothesis testing, and regression analysis. This is a calculus-based course. Statistical software is used; however, there is no lab associated with the course. Credit not given for this course and ST 511 or ST 513 or ST 515. This course does NOT count as an elective towards a degree or a minor in Statistics. Note: the course will be offered in person (Fall) and online (Fall and Summer).

Prerequisites: MA 241 or equivalent (Calculus II) and MA 405 or equivalent (Linear Algebra)
Typically offered in Fall and Summer

ST 518 Applied Statistical Methods II (3 credit hours)
This second course in statistics for graduate students is intended to further expand students' background in the statistical methods that will assist them in the analysis of data. Course covers many fundamental analysis methods currently used to analyze a wide array of data, mostly arising from designed experiments. Topics include multiple regression models, factorial effects models, general linear models, mixed effect models, logistic regression analysis, and basic repeated measures analysis. This is a calculus-based course. Statistical software is used, however, there is no lab associated with the course. Credit not given for this course and ST 512 or ST 514 or ST 516. Note: this course will be offered in person (Spring) and online (Fall and Spring).

Prerequisite: ST 517
Typically offered in Fall and Spring

ST 519/EMS 519 Teaching and Learning of Statistical Thinking (3 credit hours)
This course is designed to bridge theory and practice on how students develop understandings of key concepts in data analysis, statistics, and probability. Discussion of students' understandings, teaching strategies and the use of manipulatives and technology tools. Topics include distribution, measures of center and spread, sampling, sampling distribution, randomness, and law of large numbers. Must complete a first level graduate statistics course (ST 507, ST 511, or equivalent) before enrolling.

Prerequisite: ST 507 or ST 511
Typically offered in Spring only

ST 520 Statistical Principles of Clinical Trials (3 credit hours)
Statistical methods for design and analysis of clinical trials and epidemiological studies. Phase I, II, and III clinical trials. Principle of Intention-to-Treat, effects of non-compliance, drop-outs. Interim monitoring of clinical trials and data safety monitoring boards. Introduction to meta-analysis. There is also discussion of Epidemiological methods time permitting.

Corequisite: ST 501 or ST 521 or ST 701
Typically offered in Fall only

ST 525 Statistics and Computing for Agricultural Data Science (3 credit hours)
The fundamentals of designed experiments, analysis of variance, and regression modeling. Categorical data analysis including logistic regression will be covered. Regular access to a computer for homework, class exercises, and statistical computing is required. The emphasis in this class is on the practical aspects of statistical modeling. Assignments will concentrate on problem solving rather than formal proofs and derivations.

P: ST 511 or equivalent
Typically offered in Fall and Spring

ST 531 Experimental Design (3 credit hours)
Overview and comparison of observational studies and designed experiments followed by a thorough discussion of design principles. Review of estimation and inference for regression and ANOVA models from an experimental design perspective. Review of design and analysis for completely randomized, randomized complete block, and Latin square designs. Designs and analysis methods for factorial experiments, general blocking structures, incomplete block designs, confounded factorials, split-plot experiments, and fractional factorial designs. Examples used to illustrate application and analysis of these designs.

Prerequisite: ST 512, or ST 515, or ST 516, or ST 517, or ST 703
Typically offered in Fall only

ST 533/ST 433 Applied Spatial Statistics (3 credit hours)
Introduction to statistical models and methods for analyzing various types of spatially referenced data. The focus is on applications with real data and their analysis with statistical programs such as R and SAS. Students are required to write, modify, and run computer code in order to complete homework assignments and final projects.

P: ST 422 and ST 430
Typically offered in Spring only

ST 534/ST 434 Applied Time Series (3 credit hours)
Statistical models and methods for the analysis of time series data using both time domain and frequency domain approaches. A brief review of necessary statistical concepts and R will be given at the beginning. Analyses of real data sets using the statistical software packages will be emphasized.

Prerequisite: ST 422 and ST 430
Typically offered in Fall only

ST 535/ST 435 Statistical Methods for Quality and Productivity Improvement (3 credit hours)
Use of statistics for quality control and productivity improvement. Control chart calculations and graphing, process control and specification; sampling plans; and reliability. Computer use will be stressed for performing calculations and graphing.

Prerequisite: (ST 305 or ST 312 or ST 372) and ST 307
Typically offered in Fall only

ST 537/ST 437 Applied Multivariate and Longitudinal Data Analysis (3 credit hours)
An introduction to use of statistical methods for analyzing multivariate and longitudinal data collected in experiments and surveys. Topics covered include multivariate analysis of variance, discriminant analysis, principal components analysis, factor analysis, covariance modeling, and mixed effects models such as growth curves and random coefficient models. Emphasis is on use of a computer to perform statistical analysis of multivariate and longitudinal data.

Prerequisite: ST 422 and ST 430
Typically offered in Fall and Spring

ST 540/ST 440 Applied Bayesian Analysis (3 credit hours)
Introduction to Bayesian concepts of statistical inference; Bayesian learning; Markov chain Monte Carlo methods using existing software (SAS and OpenBUGS); linear and hierarchical models; model selection and diagnostics.

Prerequisite: ST 422 and ST 430
Typically offered in Spring only

ST 542 Statistical Practice (3 credit hours)
This course will provide a discussion-based introduction to statistical practice geared towards students in the final semester of their Master of Statistics degree. Note: the course will be offered in person (Fall) and online (Spring and Summer).

Prerequisite: (ST 512 or ST 514 or ST 516 or ST 518) and (ST 502 or ST 522 or ST 702)
Typically offered in Fall, Spring, and Summer

ST 544 Applied Categorical Data Analysis (3 credit hours)
This course focuses on the concepts, methods, and models used to analyze categorical data, particularly contingency tables, count data and binary/binomial type of data. The topics covered include Pearson Chi-squared independence test for contingency tables, measures of marginal and conditional associations, small-sample inference, logistic regression models for independent binary/binomial data and many extended models for correlated binary/binomial data including matched data and longitudinal data. The course emphasizes the implementation of methods/models using SAS and the interpretation of the results from the output.

Prerequisite: ST 512 or ST 514 or ST 515 or ST 516
Typically offered in Fall only

ST 546/MA 546 Probability and Stochastic Processes I (3 credit hours)
Modern introduction to Probability Theory and Stochastic Processes. The choice of material is motivated by applications to problems such as queueing networks, filtering and financial mathematics. Topics include: review of discrete probability and continuous random variables, random walks, markov chains, martingales, stopping times, erodicity, conditional expectations, continuous-time Markov chains, laws of large numbers, central limit theorem and large deviations.

Prerequisite: MA 421 and MA 425 or MA 511
Typically offered in Fall only

ST 555 Statistical Programming I (3 credit hours)
An introduction to programming and data management using SAS, the industry standard for statistical practice. Detailed discussion of the program data vector and data handling techniques that are required to apply statistical methods. Topics are based on the current content of the Base SAS Certification Exam and typically include: importing, validating, and exporting of data files; manipulating, subsetting, and grouping data; merging and appending data sets; basic detail and summary reporting; and code debugging. Additional topics with practical applications are also introduced, such as graphics and advanced reporting. Statistical methods for analyzing data are not covered in this course. Regular access to a computer for homework and class exercises is required. Previous exposure to SAS is not expected.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

ST 556 Statistical Programming II (3 credit hours)
Statistical procedures for importing/managing complex data structures using SQL, automated analysis using macro programming, basic simulation methods and text parsing/analysis procedures. Students learn SAS, the industry standard for statistical practice. Regular access to a computer for homework and class exercises is required.

P: ST 555 or Base SAS Certification
Typically offered in Spring and Summer

ST 558 Data Science for Statisticians (3 credit hours)
Methods for reading, manipulating, and combining data sources including databases. Custom functions, visualizations, and summaries. Common analyses done by data scientists. Methods for communicating results including dashboards. Regular access to a computer for homework and class exercises is required.

Prerequisites: (ST 511 or ST 517 or equivalent) and (ST 555 or equivalent)
Typically offered in Fall and Summer

ST 561/ECG 561 Applied Econometrics I (3 credit hours)
Introduction and application of econometrics methods for analyzing cross-sectional data in economics, and other social science disciplines, such as OLS, IV regressions, and simultaneous equations models. Students should have had a statistical methods course at the 300 level or above as well as Calculus I and II.

Typically offered in Fall only

ST 562 Data Mining with SAS Enterprise Miner (3 credit hours)
This is a hands-on course using modeling techniques designed mostly for large observational studies. Estimation topics include recursive splitting, ordinary and logistic regression, neural networks, and discriminant analysis. Clustering and association analysis are covered under the topic "unsupervised learning," and the use of training and validation data sets is emphasized. Model evaluation alternatives to statistical significance include lift charts and receiver operating characteristic curves. SAS Enterprise Miner is used in the demonstrations, and some knowledge of basic SAS programming is helpful.

Prerequisite: ST 512 or ST 514 or ST 515 or ST 516 or ST 517
Typically offered in Spring only

ST 563 Introduction to Statistical Learning (3 credit hours)
This course will introduce common statistical learning methods for supervised and unsupervised predictive learning in both the regression and classification settings. Topics covered will include linear and polynomial regression, logistic regression and discriminant analysis, cross-validation and the bootstrap, model selection and regularization methods, splines and generalized additive models, principal components, hierarchical clustering, nearest neighbor, kernel, and tree-based methods, ensemble methods, boosting, and support-vector machines.

Prerequisite: ST 512 or ST 514 or ST 515 or ST 517
Typically offered in Summer only

ST 590 Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ST 630 Independent Study (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

ST 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ST 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

ST 701 Statistical Theory I (3 credit hours)
Probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, orderstatistics, multivariate distributions, concept of random sample, derivation of many sampling distributions.

Typically offered in Fall only

ST 702 Statistical Theory II (3 credit hours)
General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests of hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency.

Prerequisite: ST 701
Typically offered in Spring only

ST 703 Statistical Methods I (3 credit hours)
Introduction of statistical methods. Examples include multiple linear regression, concepts of experimental design, factorial experiments, and random-effects modeling. A computing laboratory addresses computational issues and use of statistical software. This course is a prerequisite for most advanced courses in statistics. This section is restricted to statistics and closely related majors.

R: 17STPHD Students Only
Typically offered in Fall only

ST 704 Statistical Methods II (3 credit hours)
This course will introduce many methods that are commonly used in applications. Examples include: model generation, selection, assessment, and diagnostics in the context of multiple linear regression (including penalized regression); linear mixed models; generalized linear models; generalized linear mixed models; nonparametric regression and smoothing; and finite-population sampling basics. Coverage will include some theory, plus implementation using SAS and/or R.

Prerequisite:ST 703; Corequisites: ST 702 and ST 705
Typically offered in Spring only

ST 705 Linear Models and Variance Components (3 credit hours)
Theory of estimation and testing in full and non-full rank linear models. Normal theory distributional properties. Least squares principle and the Gauss-Markoff theorem. Estimability and properties of best linear unbiased estimators. General linear hypothesis. Application of dummy variable methods to elementary classification models for balanced and unbalanced data. Analysis of covariance. Variance components estimation for balanced data.

Corequisite: ST 702
Typically offered in Spring only

ST 706/MA 706/OR 706 Nonlinear Programming (3 credit hours)
An advanced mathematical treatment of analytical and algorithmic aspects of finite dimensional nonlinear programming. Including an examination of structure and effectiveness of computational methods for unconstrained and constrained minimization. Special attention directed toward current research and recent developments in the field.

Prerequisite: OR(IE,MA) 505 and MA 425
Typically offered in Spring only

ST 715 Theory Of Sampling Applied To Survey Design (3 credit hours)
Principles for interpretation and design of sample surveys. Estimator biases, variances and comparative costs. Simple random sample, cluster sample, ratio estimation, stratification, varying probabilities of selection. Multi-stage, systematic and double sampling. Response errors.

Prerequisite: ST 422, ST 512
Typically offered in Fall only

ST 721/GN 721 Genetic Data Analysis (3 credit hours)
Analysis of discrete data, illustrated with genetic data on morphological characters allozymes, restriction fragment length polymorphisms and DNA sequences. Maximum likelihood estimation, including iterative procedures. Numerical resampling. Development of statistical techniques for characterizing genetic disequilibrium and diversity. Measures of population structure and genetic distance. Construction of phylogenetic trees. Finding alignments and similarities between DNA sequences. Locating genes with markers.

Prerequisite: ST 430 and GN 311
Typically offered in Spring only

ST 732 Longitudinal Data Analysis (3 credit hours)
Introduction to modeling longitudinal data; Population-averaged vs. subject-specific modeling; Classical repeated measures analysis of variance methods and drawbacks; Review of estimating equations; Population-averaged linear models; Linear mixed effects models; Maximum likelihood, restricted maximum likelihood, and large sample theory; Review of nonlinear and generalized linear regression models; Population-averaged models and generalized estimating equations; Nonlinear and generalized linear mixed effects models; Implications of missing data; Advanced topics (including Bayesian framework, complex nonlinear models, multi-level hierarchical models, relaxing assumptions on random effects in mixed effects models, among others). Implementation in SAS and R.

Prerequisites: ST 702 and ST 705
Typically offered in Spring only

ST 733 Spatial Statistics (3 credit hours)
Introduction to the theory and methods of spatial data analysis including: visualization; Gaussian processes; spectral representation; variograms; kriging; computationally-efficient methods; nonstationary processes; spatiotemporal and multivariate models.

Prerequisite: ST 705
Typically offered in Spring only

ST 740 Bayesian Inference and Analysis (3 credit hours)
Introduction to Bayesian inference; specifying prior distributions; conjugate priors, summarizing posterior information, predictive distributions, hierachical models, asymptotic consistency and asymptotic normality. Markov Chain Monte Carlo (MCMC) methods and the use of exising software(e.g., WinBUGS).

Prerequisite: ST 702
Typically offered in Fall only

ST 745 Analysis of Survival Data (3 credit hours)
Statistical methods for analysis of time-to-event data, with application to situations with data subject to right-censoring and staggered entry, including clinical trials. Survival distribution and hazard rate; Kaplan-Meier estimator for survival distribution and Greenwood's formula; log-rank and weighted long-rank tests; design issues in clinical trials. Regression models, including accelerated failure time and proportional hazards; partial likelihood; diagnostics.

Prerequisite: ST 502 or ST 702
Typically offered in Spring only

ST 746/MA 746 Introduction To Stochastic Processes (3 credit hours)
Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion.

Prerequisite: MA 405 and MA(ST) 546 or ST 521
Typically offered in Spring only

ST 747/MA 747 Probability and Stochastic Processes II (3 credit hours)
Fundamental mathematical results of probabilistic measure theory needed for advanced applications in stochastic processes. Probability measures, sigma-algebras, random variables, Lebesgue integration, expectation and conditional expectations w.r.t.sigma algebras, characteristic functions, notions of convergence of sequences of random variables, weak convergence of measures, Gaussian systems, Poisson processes, mixing properties, discrete-time martingales, continuous-time markov chains.

Prerequisite: MA(ST) 546
Typically offered in Spring only

ST 748/MA 748 Stochastic Differential Equations (3 credit hours)
Theory of stochastic differential equations driven by Brownian motions. Current techniques in filtering and financial mathematics. Construction and properties of Brownian motion, wiener measure, Ito's integrals, martingale representation theorem, stochastic differential equations and diffusion processes, Girsanov's theorem, relation to partial differential equations, the Feynman-Kac formula.

Prerequisite: MA(ST) 747
Typically offered in Fall only

ST 750/ECG 750 Introduction to Econometric Methods (3 credit hours)
Introduction to principles of estimation of linear regression models, such as ordinary least squares and generalized least squares. Extensions to time series and panel data. Consideration of endogeneity and instrumental variables estimation. Limited dependent variable and sample selection models. Attention to implementation of econometric methods using a statistical package and microeconomic and macroeconomic data sets.

Prerequisite: ST 421; Corequisite: ST 422
Typically offered in Spring only

ST 751/ECG 751 Econometric Methods (3 credit hours)
Introduction to important econometric methods of estimation such as Least Squares, instrumentatl Variables, Maximum Likelihood, and Generalized Method of Moments and their application to the estimation of linear models for cross-sectional ecomomic data. Discussion of important concepts in the asymptotic statistical analysis of vector process with application to the inference procedures based on the aforementioned estimation methods.

Prerequisite: ST 421, ST 422
Typically offered in Fall only

ST 752/ECG 752 Time Series Econometrics (3 credit hours)
The characteristics of macroeconomic and financial time series data. Discussion of stationarity and non-stationarity as they relate to economic time series. Linear models for stationary economic time series: autoregressive moving average (ARMA) models; vector autoregressive (VAR) models. Linear models for nonstationary data: deterministic and stochastic trends; cointegration. Methods for capturing volatility of financial time series such as autoregressive conditional heteroscedasticity (ARCH) models. Generalized Method of Moments estimation of nonlinear dynamic models.

Prerequisite: ECG(ST) 751
Typically offered in Spring only

ST 753/ECG 753 Microeconometrics (3 credit hours)
The characteristics of microeconomic data. Limited dependent variable models for cross-sectional microeconomic data: logit/probit models; tobit models; methods for accounting for sample selection; count data models; duration analysis; non-parametricmethods. Panel data models: balanced and unbalanced panels; fixed and random effects; dynamic panel data models; limited dependent variables and panel data analysis.

Prerequisite: ECG 751
Typically offered in Spring only

ST 756/GN 756 Computational Molecular Evolution (3 credit hours)
Phylogenetic analyses of nucleotide and protein sequence data. Sequence alignment, phylogeny reconstruction and relevant computer software. Prediction of protein secondary structure, database searching, bioinformatics and related topics. Project required.

Prerequisite: GN 311 and ST 511
Typically offered in Fall only

ST 757/HS 757/GN 757 Quantitative Genetics Theory and Methods (3 credit hours)
The essence of quantitative genetics is to study multiple genes and their relationship to phenotypes. How to study and interpret the relationship between phenotypes and whole genome genotypes in a cohesive framework is the focus of this course. We discuss how to use genomic tools to map quantitative trait loci, how to study epistasis, how to study genetic correlations and genotype-by-environment interactions. We put special emphasis in using genomic data to study and interpret general biological problems, such as adaptation and heterosis. The course is targeted for advanced graduate students interested in using genomic information to study a variety of problems in quantitative genetics.

Prerequisite: ST 511
Typically offered in Fall only

ST 758 Computation for Statistical Research (3 credit hours)
Computational tools for research in statistics, including applications of numerical linear algebra, optimization and random number generation, using the statistical language R. A project encompassing a simulation experiment will be required.

Prerequisite: ST 702 and ST 705
Typically offered in Fall only

ST 771/BMA 771/MA 771 Biomathematics I (3 credit hours)
Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories oftwo and more species systems (predator-prey, competition, symbosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structureof models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.

Prerequisite: Advanced calculus, reasonable background in biology
Typically offered in Fall only

ST 772/BMA 772/MA 772 Biomathematics II (3 credit hours)
Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.

Prerequisite: BMA 771, elementary probability theory
Typically offered in Spring only

ST 773/BMA 773/MA 773/OR 773 Stochastic Modeling (3 credit hours)
Survey of modeling approaches and analysis methods for data from continuous state random processes. Emphasis on differential and difference equations with noisy input. Doob-Meyer decomposition of process into its signal and noise components. Examples from biological and physical sciences, and engineering. Student project.

Prerequisite: BMA 772 or ST (MA) 746
Typically offered in Spring only

ST 779 Advanced Probability for Statistical Inference (3 credit hours)
Sets and classes, sigma-fields and related structures, probability measures and extensions, random variables, expectation and integration, uniform integrability, inequalities, L_p-spaces, product spaces, independence, zero-one laws, convergence notions, characteristic functions, simplest limit theorems, absolute continuity, conditional expectation and conditional probabilities, martingales.

Prerequisite: ST 702
Typically offered in Spring only

ST 790 Advanced Special Topics (1-6 credit hours)
Typically offered in Fall, Spring, and Summer

ST 793 Advanced Statistical Inference (3 credit hours)
Statistical inference with emphasis on the use of statistical models, construction and use of likelihoods, general estimating equations, and large sample methods. Includes introduction to Bayesian statistics and the jackknife and bootstrap.

Prerequisite: ST 702
Typically offered in Fall only

ST 801 Seminar (1 credit hours)
Typically offered in Fall and Spring

ST 810 Advanced Topics in Statistics (1-3 credit hours)
Typically offered in Fall and Spring

ST 835 Readings (1-3 credit hours)
Typically offered in Spring only

ST 841 Statistical Consulting (1 credit hours)
Participation in regularly scheduled supervised statistical consulting sessions with faculty member and client. Consultant's report written for each session. Regularly scheduled meetings with course instructor and other student consultants to present and discuss consulting experiences.

Prerequisite: ST 512 and ST 702
Typically offered in Fall only

ST 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planing for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

ST 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation Research

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

ST 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

ST 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour requirements, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Sustanaible Materials and Technology (SMT)

SMT 200 Introduction to Sustainable Materials and Technology (3 credit hours)
The overall goal of the class is to introduce the students to the properties and production, and environmental implications, of common materials, including biobased, metals, plastics and mineral based. The class will connect the structure and mechanical properties of these common materials with the technology used for producing the materials from raw ingredients, and also the processing of these materials into useful items. In addition to the material properties, the environmental impacts, e.g., emissions of carbon, water, and pollutants, will be discussed. The concepts of embodied energy, mass and energy balances, water and land use will all be considered. The concept of Life Cycle Analysis will be introduced and used to evaluate the production of different building materials.

Restriction: SMT majors or with the permission of the instructor
Typically offered in Fall only

SMT 201 Sustainable Materials for Green Housing (2 credit hours)
Sustainable Materials for Green Housing

GEP Interdisciplinary Perspectives
Typically offered in Spring only

SMT 202 Anatomy and Properties of Renewable Materials (3 credit hours)
Formation, cell morphology, cell wall, structure of softwoods, hardwoods, and other renewable materials; variability, naturally occurring defects, biological deterioration, and basic physical and mechanical properties of renewable materials in relation to products utilization. Techniques on hand lens and microscopic identification of renewable materials.

GEP Natural Sciences
Typically offered in Fall only

SMT 203 Physical Properties of Sustainable Materials (4 credit hours)
Basic concepts involving the interaction of sustainable materials with moisture, heat, and electricity. Concepts needed to perform calculations related to material balance, energy balance, mass transfer by diffusion, and heat transfer by conduction. Principles and application of basic techniques for characterizing the physical properties of materials and for drying of lumber.

Typically offered in Spring only

SMT 206 Wood Manufacturing Site Visits (1 credit hours)
Examples of the practical implementation of the value added processes within the wood products industry. Visits to wood products industries will be representative of the primary breakdown and secondary value added product operations that will expand and reinforce classroom instruction. Five days are spent visiting industries to provide an appreciation for the range of products and processes. The student is responsible for room and board; transportation and personal protective equipment are provided.

P: SMT 240
Typically offered in Summer only

SMT 207 Principles of Sustainable Product Development Lecture (2 credit hours)
This course is a Human-Centered Design (HCD) approach that involves the interdisciplinary integration of user, ergonomics, and aesthetic needs with technological and production methods to create manufacturable products. Product Development Principles cover user/object interaction, product form, innovation, redesign, and sustainable product development involving materials from natural resources. Students will conduct a research product analysis and translate preexisting products and analyze creative development methods. Minimal ideation to emphasize the product development comprehension.

C: SMT 217 for 15SMTBS students
Typically offered in Fall only

SMT 210 Sustainable Materials Internship (1 credit hours)
Experience in the forest products or related industries with a departmentally selected employer. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Completion of summer practicum
Typically offered in Fall, Spring, and Summer

SMT 217 Principles of Sustainable Product Development Laboratory (1 credit hours)
This lab course is a Human-Centered Design (HCD) approach that involves the interdisciplinary integration of user, ergonomics, and aesthetic needs with technological and production methods to create manufacturable products. Product Development Principles cover user/object interaction, product form, innovation, redesign, and sustainable product development involving materials from natural resources. Students will justify research from SMT 207 with product analysis and ideation with reflective recordings--sketching and hands-on projects that emphasize product development.

C: SMT 207
Typically offered in Fall only

SMT 232 Recycling to Create a Sustainable Environment (2 credit hours)
The goal of this class is to link the impetus for recycling and recycled materials to the building of a sustainable world. Recycling efficiencies for various materials will be examined as well as recycling practices and attitudes in other parts of the world. This course will explore the technology, economics, markets, trade and social impacts due to the recycling of materials. Case studies will provide an in-depth examination of the problems and potentials for the recycling of selected recycled materials. The use of Life Cycle Analysis (LCA) to evaluate recycling alternatives will be introduced. The economic, policy, social and resource availability drivers for recycling will be examined as well as the technological, economic, market and social barriers to recycling.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

SMT 240 Introduction to Wood Products Industries (2 credit hours)
An introduction to wood products including the products and their characteristics produced by the primary and secondary wood products industries, pulp and paper industry, energy and chemical products produced from wood.

P: SMT 202 or permission of the instructor
Typically offered in Spring only

SMT 293 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Summer

SMT 294 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the freshman and sophomore level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Summer

SMT 295 Special Topics in Sustainable Materials and Technology (1-3 credit hours)
Special Topics in Wood Products at the 200 level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

SMT 301 Chemistry of Sustainable Materials (3 credit hours)
Introduction of polymer science concepts (thermal transitions, molecular weight, viscoelasticity) to sustainable materials such as wood, cork, starch, silk, etc. Detailed instruction on the chemistry of sustainable materials including reactivity, decay, the chemical aspects of thermal treatments, the separation of sustainable materials into their individual components, the reactivity and modification of the individual components, and the conversion of sustainable materials into energy products.

Prerequisite: CH 101 and CH 102 and CH 220
Typically offered in Spring only

SMT 302 Processing of Biomaterials (4 credit hours)
Principles of the manufacturing processes used in the sustainable and renewable materials industries. Content includes primary and secondary manufacturing, theory of machining basics, and biomaterials-based composite fabrication. Field trips might require meeting outside of class time.

Prerequisite: SMT 202 or SMT 203
Typically offered in Spring only

SMT 307 Product Visualization (3 credit hours)
This course covers the visual representation of objects intended for product development using 3D CAD software. Parametric solid modeling of parts and assemblies and creating orthographic views drawings using Solidworks, Rhinoceros and additional CAD software. This course is intended to visually enhance product development ideation. We will also study other forms of technology for ideation, for example, but not limited to 3D printing, 3D scanning, Laser Cutter/Engraver, and CNC machines. In this course, students will conduct research and produce solutions focusing on sustainability with 2D and 3D visual communication development.

P: SMT 207 and SMT 217
Typically offered in Spring only

SMT 308 Wood Processing (4 credit hours)
Principles of the manufacturing processes used in the wood products industries. Content includes primary and secondary manufacturing, theory of machining basics, and solid wood and wood-based composite fabrication. Field trips might require meeting outside of class time.

SMT 202 and SMT 240 or permission of the instructor
Typically offered in Fall only

SMT 310 Introduction to Industrial Ecology (3 credit hours)
In this course, students will explore the main concepts of industrial ecology for sustainable materials. Students will learn about environmental supply chain, manufacturing of products from sustainable materials such as wood and agricultural materials, and how we can learn from nature to close the manufacturing loop. To support the activities in these technical areas, students will also learn how to better manage time, how to work efficiently in teams, and how best to interact with their co-workers.

GEP Interdisciplinary Perspectives
Typically offered in Fall only

SMT 320 Industrial Chemical Pollutants (2 credit hours)
Introduction to the sources, fates, and analysis of common chemical pollutants from industrial sources. Content will focus predominantly on chemicals from industries related to the production and use of sustainable materials such as wood, bamboo, cork, silk, renewable plastics, etc.

P: SMT 301
Typically offered in Spring only

SMT 330 Project Management for Sustainability (3 credit hours)
Main concept and principles of Project Management (PM). Different tools utilized in project management will be covered. Relationship between project management and sustainability will be emphasized. With the concepts and tools learned in class, students will learn how to better manage their time, how to work efficiently in teams, and how best to interact with their superiors.

Restriction: Junior or Senior Standing
Typically offered in Fall only

SMT 346 Sustainable Materials Business Marketing (3 credit hours)
This course will examine the business and marketing approaches in the forest products industry from a theoretical as well as an applied perspective. Students will learn the importance of business processes and how products, price, distribution, and promotion plays a role in the purchase behavior of consumers. Students will analyze situations and cases to solve real and hypothetical business problems in the forest products industry.

Typically offered in Spring only

SMT 441 Mechanical Properties of Sustainable Materials (4 credit hours)
Overview of statics. Concepts of stress and strain. Mechanical properties of elastic and viscoelastic materials. Application of elastic theory to axial loading and bending, orthotropic elasticity of lamina and laminates, buckling of columns. Principles and application of basic techniques for characterizing the mechanical properties of sustainable materials.

Prerequisite: MA 121 and PY 211 and SMT 203
Typically offered in Spring only

SMT 444 Sustainable Composites and Biopolymers (3 credit hours)
Manufacture, properties, and processing of lignocellulosic composites and polymers such as laminates, strandboard, particleboard, fiberboard, and nanocomposites. Principles and application of basic techniques for manufacture and testing of composites according to product and quality standards.

Prerequisite: SMT 301 and Senior standing in SMT
Typically offered in Fall only

SMT 450 Sustainable Business and Innovation (2 credit hours)
Theories, practice and case studies of sustainability and innovation in corporate settings. Content will include sustainability and environmental management, innovation, new business development and R&D, change management, corporate strategy and strategic alignment.

Prerequisite: Junior or senior standing
Typically offered in Fall only

SMT 483 Capstone in Sustainable Materials and Technology (3 credit hours)
Capstone course in sustainable materials and technology; integration of sustainable material and technology concepts with economic, environmental, and societal considerations; case studies and practicum in sustainable materials and technologies.

Restricted to students with Senior Standing in SMT
Typically offered in Spring only

SMT 493 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

SMT 494 Independent Study in Sustainable Materials & Technology (1-6 credit hours)
Independent Study for Sustainable Materials & Technology students at the advanced level developed under the direction of a faculty member. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

Technology Education (TED)

TED 530 Foundations for Teaching Technology (3 credit hours)
Three topics related to teaching technology at the secondary and post-secondary levels: philosophical and historical foundations; methodology and curriculum development; and current trends and issues. Emphasis is on developing critical thinking skills, research, technology skill development, and writing procedures.

Prerequisite: Graduate standing
Typically offered in Fall only

TED 532 Current Trends in Technical Graphics Education (3 credit hours)
Current trends in the technology, techniques, and theories relating to technical graphics education. Discussion will center on assigned readings and student-researched presentations on topical subjects. Readings will be drawn from journals and texts, on-line databases and articles, and current news media sources.

Prerequisite: Graduate standing
Typically offered in Fall only

TED 534 Instructional Design in Technical and Technology Education (3 credit hours)
Create instructional activities for technical and technology education. Examine learning theories appropriate for technical and technology education. Explore and apply models for instructional design. Examine issues relative to electronic applications in technical and technology education classrooms.

Prerequisite: Graduate standing
Typically offered in Spring only

TED 536 Scientific and Technical Visualization: Theory and Practice (3 credit hours)
Theory and practice of scientific and technical visualization as a means of displaying scientific data and concepts using graphical methods. Both practitioner and theory driven models of communication are considered. How computer and print graphics can be used to assist individuals in the exploration of scientific and technical concepts. Particular focus on how to integrate scientific/technical graphics into the instructional settings.

TED 551 Technology Education: A Discipline (3 credit hours)
Defines essential attributes of technology and examines the relationship between technology education and related disciplines. Analyzes the theory, models, and literature that constitute the foundation of technology education. Synthesizes relevantresearch and identifies areas of needed research.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 552 Curricula for Emerging Technologies (3 credit hours)
Analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 555 Developing and Implementing Technology Education (3 credit hours)
Technology Education curriculum trends, standards, design, implementation and management. Students will analyze current curricular trens and develop strategies for implementing and managing technology education programs.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 556 Laboratory Management and Safety in TED (3 credit hours)
Laboratory management, planning, and safety considerations for technology education. Analysis of recent research, environmental factors, development of a safety system, safety education, and legal implications. Use of student leaders in managementof a safe learning environment. Offfered by Distance Education Only

Prerequisite: Graduate standing
Typically offered in Spring only

TED 558 Teaching Creative Problem Solving (3 credit hours)
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 601 Practicum in Technology Education (1-6 credit hours)
Faculty supervised experience in educational, industrial or governmental setting where a student analyzes activities associated with planning, implementing and evaluating instructional and/or services in technology education. This plan is developedby students and approved by supervisor.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 602 Practicum in TED (1-3 credit hours)
Typically offered in Summer only

TED 610 Special Topics in Technology Education (1-6 credit hours)
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 621 Special Problems in Technology Education (1-6 credit hours)
Guided independent or group or current problems in technology education.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 641 Internship in Technology Education (3 credit hours)
Classroom teachers will document products of learning to include: content pedagogy, student development, multiple instructional strategies, motivation and management, professional growth and community involvement.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 646 Field-based Research in Technology Education (3 credit hours)
Employ methods of field-based research to examine and improve instructional effectiveness and student achievement.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 655 Internship in Graphic Communications Education (3 credit hours)
Mentoring during a higher education level teaching experience in the field of technical graphics with emphasis on providing help in teaching visualization, graphical sciences, and technical graphics standards. *Course is offered as needed to 2-3 students at a time (independent Study).

Prerequisite: TED 530 or EOE 751 with Consent of Instructor
Typically offered in Fall and Spring

TED 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

TED 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Spring and Summer

TED 692 Research Project in Technology Education (1-6 credit hours)
A project or problem in research in education for graduate students, supervised by members of graduate faculty. The research chosen on the basis of individual students' interests and not to be part of thesis or dissertation research.

Prerequisite: ELP 732
Typically offered in Spring only

TED 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TED 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Typically offered in Fall, Spring, and Summer

TED 696 Summer Thesis Res (1 credit hours)

TED 709 Seminar in Technology Education (1-3 credit hours)
Seminar type course with toics selected for each class with attention given to broad concepts of and issues facing technology education at each leels of delivery and implementation.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 751 Technology Education: A Discipline (3 credit hours)
Defines essential attributes of technology and examines the relationship between technology education and related disciplines. Analyzes the theory, models, and literature that constitute the foundation of technology education. Synthesizes relevantresearch and identifies areas of needed research.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 752 Curricula for Emerging Technologies (3 credit hours)
Analyze advanced technologies and develop instructional programs for technology education curricula in secondary schools. Topics include technologies in production, transportation and communication.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TED 755 Developing and Implementing Technology Education (3 credit hours)
Technology Education curriculum trends, standards, design, implementation and management. Students will analyze current curricular trens and develop strategies for implementing and managing technology education programs.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 756 Planning of Change in TED (3 credit hours)
Theories, research, strategies and practices needed to function as a technology education change agent; demonstrate a working knowledge of planned change in technology education; observe, assess, design and competently plan intervention strategies and aptly use behavioral tools to achieve success.

Typically offered in Summer only

TED 757 Leadership Development in TED (3 credit hours)
Research, development and practice of individual and organizational leadership in technology education. Content builds leadership knowledge, skill and practice with emphasis on student assesment and development.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 758 Teaching Creative Problem Solving (3 credit hours)
Provides teachers with the opportunity to study the research associated with creativity and apply these theories to implement a creative problem solving program.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TED 801 Practicum in Technology Education (1-6 credit hours)
Faculty supervised experience in educational, industrial or governmental setting where a student analyzes activities associated with planning, implementing and evaluating instructional and/or services in technology education. This plan is developedby student and approved by supervisor.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 810 Special Topics in Technology Education (1-6 credit hours)
Individual or group of special topics in professional education. The faculty member determines the topic and mode of study after discussion with students.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TED 821 Special Problems in Technology Education (1-6 credit hours)
Guided independent or group or current problems in technology education.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TED 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TED 896 Summer Dissert Res (1 credit hours)

TED 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

Technology Engineering and Design Education (TDE)

TDE 101 Introduction to Technology Education (1 credit hours)
Orientation to technology teacher education curricula. Overview of the philosophy, objectives and scope of technology education programs in the public schools, multicultural and individual differences of students. A study of current technology issues will be conducted throughout the course.

Typically offered in Fall only

TDE 110 Materials & Processes Technology (3 credit hours)
Basic knowledge and skills needed to process common materials and produce functional products of woods, metals, plastics, and composite materials. Includes laboratory safety, use of hand tools, operation of materials, and teaching strategies. Laboratory experiences in materials testing and construction of multi-material projects.

Typically offered in Fall and Spring

TDE 131 Technology through Engineering and Design I (3 credit hours)
Study of engineering and design processes used to solve technological problems, innovate and invent. Students will actively design, model and test solutions to technological problems and explore methods to teach middle and high school students about engineering design and the design process.

Prerequisite: TDE 110
Typically offered in Fall and Spring

TDE 202 Introduction to Teaching Technology Engineering and Design Education (2 credit hours)
This course introduces students to teaching technology, engineering, and design in middle and secondary schools. Students will become familiar with state standards and national recommendations for teaching technology, engineering, and design. The co-requisite for this course has a required fieldwork component in local middle and secondary schools, and students are responsible for their own transportation to and from their field experience sites. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

Prerequisite: Sophomore standing; Corequisite: ED 204
Typically offered in Fall only

TDE 205 Desktop Publishing and Imaging Technology (3 credit hours)
An introduction to digital document production and techniques. Explores software packages used in producing documents for print. Structured for public school teachers and other interested persons, the course introduces basic standards and concepts of page layout, copyright and trademark laws, document usability, readability, and methods of document production.

Typically offered in Fall and Spring

TDE 220 Civil Engineering Graphics (3 credit hours)
Civil engineering graphics is an introductory course in basic graphic principles for constructed facilities. The emphasis is on sketching and CAD (computer-aided design) drawing skills and how specific construction systems and materials selected for a design affect production of civil engineering drawings for buildings, residences, and other constructed facilities through CAD. Topics include orthographic and axonometric engineering drawing of site plans, plat plans, section details, utility structure details, elevations and related topics. Restricted to Civil Engineering Majors.

Typically offered in Fall and Spring

TDE 230 Scientific and Technical Visualization (3 credit hours)
Scientific and technical visualization is an introductory course providing orientation to communication of scientific and technical information with graphics. Using current practice in science, technology, and engineering disciplines as the context, the class will use general and discipline-specific techniques to explore how to effectively communicate with graphics. Both manual and current software and computer technologies will be used to design and create graphics. Students will also learn to critically examine and discuss graphics produced by themselves and others.

Prerequisite: TDE 205
Typically offered in Spring only

TDE 261 Digital Media Education (3 credit hours)
Image creation and control, aesthetics, production processes and environments, and media transfer are explored. This course emphasizes concepts of audio and video design, various digital media technologies, and nonlinear editing concepts through laboratory experiments and projects in radio, television, original audio development, and video production. TDE Majors or instructor permission.

Typically offered in Spring only

TDE 331 Technology Through Engineering and Design II (3 credit hours)
Students will explore the contributions of systems engineering for developing and sustaining our designed world. Appropriate measurement, analysis and simulation tools will be used to make informed decisions and solve problems. Students will explore methods to teach middle and high school students about engineering design and the design process. TDE Majors or instructor approval.

Prerequisite: TDE 131
Typically offered in Fall and Spring

TDE 351 Ceramics: The Art and Craft of Clay (3 credit hours)
Contemporary and historical examples of the art and craft of ceramics will be studied. Experiences in designing ceramic forms and expressing individual ideas through the medium of clay.

GEP Visual and Performing Arts

TDE 359 Electronics Technology (3 credit hours)
Direct current, alternating current, and semiconductors. Measurement and circuit behavior. Experimentation with application circuits.

Prerequisite: Junior Standing
Typically offered in Fall only

TDE 371 Emerging Issues in Technology (3 credit hours)
Examination of current and projected technology topics which are growing in importance but are not presently reflected in the Technology Education programs of NC public schools. Laboratory experiences include development, revision, and field testing of appropriate learning activities for middle and high school students in the selected topic areas.

Prerequisite: TDE 131
Typically offered in Fall only

TDE 385 Robotics Education (3 credit hours)
This course is an introduction to design and invention system control mechanisms and robot sensors. Students will classify foundational technical developments in autonomous and computer- and radio-control robot teleoperations. Students will explore the history and evolution of robots and automation and their social, economic, industrial, and educational impacts.

Prerequisite: Junior standing.
Typically offered in Spring only

TDE 386 Robotics Education Lab (3 credit hours)
Students will apply technological problem solving skills toward 21st century design and innovation. This includes experiences multiple robotics design and invention systems and related programming and designing, prototyping, and programming an autonomous robot to resolve a real world issue.

Corequisite: TDE 385
Typically offered in Spring only

TDE 407 Field Work in Technology Education (6 credit hours)
A supervised off-campus field experience in Technology, Engineering, and Design Education that relates on-the-job experiences in the field to the technical competencies that are the content of the curriculum. This course has a required fieldwork component in a workplace, and students are responsible for their own transportation to and from their field experience sites.

Co-requisite: TDE 452, Senior Standing
Typically offered in Spring only

TDE 452 Lab Planning in Technology Education (3 credit hours)
Laboratory planning, management, and safety for technology education. Physical layout, selection, specification, and cost of equipment; the safe operation, repair and maintenance of power and hand tools; specification of expendable supplies, estimating, and ordering.

Restriction: Senior Standing; Corequisite: TDE 407 or TDE 457
Typically offered in Spring only

TDE 456 Curriculum and Methods in Technology Education (4 credit hours)
Methods of teaching Technology Education. Emphasis on curriculum development, instructional methods, laboratory instruction, meeting needs of special populations, and management of student organizations. Field experiences and course assignments two hours each week. Students are responsible for their own transportation.

Prerequisite: Technology Education Majors, Admittance to teacher education candidacy
Typically offered in Fall only

TDE 457 Student Teaching in Technology Education (8 credit hours)
Skills and techniques involved in teaching technology education through practice in a public school setting. The co-requisite for this course has a required fieldwork component in local middle and secondary schools, and students are responsible for their own transportation to and from their field experience sites. Students are required to purchase internship liability insurance to participate in this course. Contact University Insurance & Risk Management for details on acquiring the insurance and the current charge.

Prerequisite: TDE 456 and Corequisite: TDE 452
Typically offered in Spring only

TDE 481 Research & Development in Technology Education (3 credit hours)
Senior design, research, and development experience in technology education. Students research a problem, ideate potential solutions, select a final solution, construct a prototype, and complete a final report analyzing the chosen solution.

Prerequisite: TDE 331
Typically offered in Fall and Spring

TDE 490 Special Problems in Technology Education (1-6 credit hours)
Supervised, independent investigation in a defined area of interest in Technology Education.

Prerequisite: Junior standing.
Typically offered in Fall and Spring

TDE 495 Senior Seminar in Technology Education (3 credit hours)
An in-depth investigation of a topic or a set of problems and/or issues in Technology Education.

Prerequisite: Junior standing.
Typically offered in Spring only

TDE 498 Independent Study in Technology Education (1-3 credit hours)
Individual or group study of special topics in professional technology education. The topic and mode of study are determined by the faculty member after discussion with the student. May be repeated for a maximum of 6 credits. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing.
Typically offered in Fall, Spring, and Summer

Textile and Apparel Management (TAM)

TAM 589 Special Studies In Textile Management and Technology (1-4 credit hours)
New or special course on developments in textile management and technology. Specific topics and prerequisites vary.

Prerequisite: Senior standing
Typically offered in Fall and Spring

Textile Chemistry (TC)

TC 530 The Chemistry Of Textile Auxiliaries (3 credit hours)
Industrially important textile chemicals used for enhancing fiber and fabric properties such as durable press, water repellency, anti-soiling, flame retardancy, softness, stiffness, lubricity and other uses. Correlation of effect with structure, end-use influences, interaction with fabric and fibers, sources and synthetic routes, economic and environmental considerations.

Prerequisite: One yr. of organic chemistry
Typically offered in Spring only

TC 561/MSE 561 Organic Chemistry Of Polymers (3 credit hours)
Principles of step reaction and addition polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.

Prerequisite: TC 461 and CH 231 or CH 431
Typically offered in Fall only

TC 565 Polymer Applications and Technology (3 credit hours)
Poly(olefins), poly(vinyl chloride), poly(vinyl acetate), poly(urethanes), epoxies, silicones, styrene copolymers used as textile finishes, nonwoven binders, fabric coatings, composites, adhesives, foams, carpet backing adhesives. Emphasis upon synthesis, industrial processes, properties and products.

Prerequisite: One yr. of organic chemistry, TC 461
Typically offered in Spring only

TC 589/TE 589/TMS 589 Special Studies In Textile Engineering and Science (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

TC 601 Seminar (1 credit hours)
Discussion of scientific articles and presentations; review and discussion of student papers and research problems.

Typically offered in Fall and Spring

TC 630 Independent Study (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

TC 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

TC 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TC 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TC 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TC 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall and Spring

TC 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TC 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall only

TC 704 Fiber Formation--Theory and Practice (3 credit hours)
Practical and theoretical analysis of the chemical and physical principles underlying conventional methods of converting bulk polymer to fiber; rheology; melt, dry and wet polymer extrusion; fiber drawing; heat setting; general theory applied to unit processes.

Prerequisite: MA 341, PY 208
Typically offered in Spring only

TC 705 Theory Of Dyeing (3 credit hours)
Mechanisms of dyeing. Application of thermodynamics to dyeing systems. Kinetics of diffusion in dyeing processes.

Prerequisite: CH 433
Typically offered in Spring only

TC 706 Color Science (3 credit hours)
Basis of modern techniques for color specification, measurement, control and communication. Applications of color science to textiles, plastics, color reproduction, computer-based imaging and display systems. Basic concepts taught by computer color graphics.

Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 707
Typically offered in Fall only

TC 707 Color Laboratory (1 credit hours)
Exercises with modern methods and equipment to aid in understanding color perception, color science and color measurement. Computer color graphics exercises for comprehension of basic concepts. Independent projects in color science. Limited enrollment.

Prerequisite: Senior standing or Graduate standing in TC, Corequisite: TC 706
Typically offered in Fall only

TC 710/FPS 710 Science of Dye Chemistry, Dyeing, Printing and Finishing (3 credit hours)
The primary course purpose is to gain a strong fundamental understanding of the chemistry and technology of preparation, dyes, dyeing and finishes. Emphasis will be on the chemistry of different bleach activators, surfactants, photophysics and photochemistry of FWAs, modulations of dyes structures to influence color, tinctorial strength, light fastness, wash fastness and aggregation. Chemistry of different dye classes will be studied with emphasis on structure-property relationships and dye-fiber interactions. Dyeing isotherms (Nernst and Langmuir), kinetics of dyeing with emphasis on derivation of Nernst and Langmuir based on thermodynamics and kinetics principles will be covered with practical examples of dyeing at different temperature and how to calculate thermodynamic parameters of dyeing (entropy, standard affinity and isotherm constants of Nernst and Langmuir). Chemistry of different finishes, including soil release, chemistry of flame retardants and mechanisms of flame retardancy, antimicrobial and water and oil repellency, will be covered with emphasis on structure-property relationships.

Prerequisite: Graduate Standing and C or better in CH221 or CH225 and CH223 or CH227
Typically offered in Fall and Spring

TC 720 Chemistry Of Dyes and Color (3 credit hours)
Correlation of color and chemical constitution, synthetic routes for popular dyes of all important types; electronic mechanisms for reactive dyes; chemistry of dye interactions with light, washing and other in-use influences; economic and environmental considerations.

Prerequisite: (CH 221 or CH 225) and (CH 223 or CH 227)
Typically offered in Spring only

TC 771 Polymer Microstructures, Conformations and Properties (3 credit hours)
Exploration of connections between microstructures and properties of polymers afforded by analysis of their conformational characteristics. Analysis of NMR spectroscopy and conformational energy estimates to establish polymer microstructures and resultant sizes and shapes of polymer chains, which then related to their unique and rich variety of physical properties.

Prerequisite: CH 220
Typically offered in Fall only

TC 791 Special Topics In Textile Science (1-6 credit hours)
Intensive treatments of selected topics in textile, polymer and fiber science.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall and Spring

TC 792 Special Topics In Fiber Science (1-6 credit hours)
Study of selected topics of particular interest in various advanced phases of fiber science.

Typically offered in Fall and Spring

TC 896 Summer Dissert Res (1 credit hours)

Textile Engineering (TE)

TE 105 Textile Engineering: Materials and Systems (2 credit hours)
Introducation to textile engineering, polymers and fibers with emphasis on applications. Discussions of what makes macromolecules unique and pairing of material properties to a given application. Other discussions by various TE faculty giving students a picture of the breadth of the program. This course will also help develop leadership/team work skills and oral/written communications.

Corequisite: CH 101
Typically offered in Spring only

TE 110 Computer-Based Modeling for Engineers (3 credit hours)
Introductory course in computer-based modeling and programming using Visual Basic for Applications. Emphasis on algorithm development and engineering problem solving. Methodical development of VBA within applications like Microsoft Excel and Access from specifications; documentation, style; control structures; classes and methods; data types and data abstraction; object-oriented programming and design; graphical user interface design. Projects: design problems from electrical, industrial, textile, and financial systems. Functional relationships will be given and programs will be designed and developed from a list of specifications.

Prerequisite: E 115, Corequisite: MA 141
Typically offered in Fall only

TE 200 Introduction to Polymer Science and Engineering (3 credit hours)
Science and engineering of large molecules. Correlation of molecular structure and properties of polymers in solution and in bulk. Introductory polymer synthesis and kinetics. Analysis of physical methods for characterization of molecular weight, morphology, rheology, and mechanical behavior. The content will be focused on polymer synthesis, structure, and properties. The course will focus on a thorough understanding of polymer concepts and definitions, equations to calculate properties, and equipment used to measure properties.

Prerequisite: Grade of C- or better CH 101
Typically offered in Fall and Spring

TE 201 Fiber Science (4 credit hours)
Structure, physical and mechanical properties of fibers; structure of fiber assemblies. Structure/property relations. Laboratory exercises in characterization of fiber properties.

Prerequisite: CH 101 and (Grade of C- or better in MA 131 or MA 141)
Typically offered in Spring only

TE 205 Analog and Digital Circuits (4 credit hours)
Fundamentals of analog and digital circuit analysis and design. The course will present the systematic analysis and design of AC and DC circuits using Ohms and Kirchhoff's laws, the node voltage method, Thevenin and Norton's theorem, Laplace Transforms, resistance, capacitance, inductance, operational amplifiers, and frequency response. Next, the design of combinatorial and synchronous sequential circuit design will be covered using Karnaugh maps, laws of Boolean algebra, flip-flops, state machines, and latches. Laboratory exercises will supplement the topics presented in class.

Prerequisite: C- or better in TE 110, PY 208, Corequisite: MA 341
Typically offered in Spring only

TE 301 Engineering Textile Structures I: Linear Assemblies (3 credit hours)
Engineering analysis of textile structures, especially yarns. Unit processes of production, handling and packaging. Production sequences, intermachine effects, machine design and their consequences on the textile product.

Prerequisite: (MAE 206 or CE 214) and MA 242
Typically offered in Fall only

TE 302 Textile Manufacturing Processes and Systems II (4 credit hours)
Mechanisms used in the production of woven, knitted and nonwoven fabrics. Design and operation of these mechanisms and their impact on the fabric. System dynamics of the different fabric forming processes.

Prerequisite: TE 301 and C- or better in TE/ISE 110
Typically offered in Spring only

TE 303 Thermodynamics for Textile Engineers (3 credit hours)
Introduction to the concept of energy and the laws governing the transfer and transformation of energy with an emphasis on thermodynamic properties and the First and Second Laws of Thermodynamics. The fundamentals of thermodynamics will be emphasized, although more applied examples and problems will be heavily utilized.

Prerequisite: MA 242, PY 208
Typically offered in Fall only

TE 401 Textile Engineering Design I (4 credit hours)
The design process including initial specification, design constraints, sources of information and design strategy. Development of fact-finding ability in areas unfamiliar to the student. Analysis of existing designs and the development of improved or new designs.

Prerequisite: TE 302
Typically offered in Fall only

TE 402 Textile Engineering Design II (4 credit hours)
Application of textile engineering principles using team approach to design, construct and analyze novel engineering solutions to textile industry problems. Evaluation of design to assess the impact on worker, industry and society.

Prerequisite: TE 401
Typically offered in Spring only

TE 404 Textile Engineering Quality Improvement (3 credit hours)
Defining and quantifying quality of textile products; quality improvement using statistical process control (SPC) and design of experiment (DOE) techniques.

Prerequisite: ST 370 and C- or better in TE/ISE 110
Typically offered in Spring only

TE 424 Textile Engineering Quality Improvement Laboratory (1 credit hours)
Application of process improvement methods to textile systems using statistical software. Laboratory supplements lecture material presented in TE 404.

Corequisite: TE 404
Typically offered in Spring only

TE 435/CHE 435 Process Systems Analysis and Control (3 credit hours)
Dynamic analysis and continuous control of chemical and material engineering processes. Process modeling; stability analysis, design and selection of control schemes. Solution of differential equations using Laplace transform techniques.

Prerequisite: (MA 341 and TE 205) or CHE 312
Typically offered in Fall and Spring

TE 440/TE 540 Textile Information Systems Design (4 credit hours)
Textile information system design, real-world constraints. Principles of hardware, software, security and ethics issues. Emphasis on solving a real world problem. Credit will not be given for both TE 440 and TE 540.

Prerequisite: C- or better in TE 110 and JR standing
Typically offered in Fall only

TE 463 Polymer Engineering (3 credit hours)
Chemical and physical properties of polymers and fibers; thermodynamics of crystallization, time dependent phenomena, fracture mechanics and rheology. Advanced topics in extrusion.

Prerequisite: MSE 201 or BME 203; and Corequisite: TE 303, MAE 301, or MSE 301
Typically offered in Fall only

TE 466/BME 466/TE 566/BME 566 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioresorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)
Typically offered in Fall only

TE 467/BME 467 Mechanics of Tissues & Implants Requirements (3 credit hours)
Application of engineering and biological principles to understand the structure and performance of tendons, ligaments, skin, and bone; bone mechanics; viscoelasticity of soft biological tissues; models of soft biological tissues; mechanics of skeletal muscle; and tissue-derived devices as well as interfaces between native tissues and synthetic devices.

Prerequisite: (ZO 160 or BIO 183) and (MAE 214 or CE 225)
Typically offered in Spring only

TE 492 Special Topics in Textile Engineering (1-3 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.

Typically offered in Fall and Spring

TE 505 Textile Systems and Control (3 credit hours)
Theory and application of instruments and control systems used in modern textile plants. Description of basic instruments and computer systems along with their use in process control, production control, research and development.

Prerequisite: TE 305, CSC 114
Typically offered in Spring only

TE 518 Textile Electronics - Materials and Systems (3 credit hours)
For electronics integration, textiles are considered an unconventional substrate and a potentially disruptive technology space within wearable electronics. The objective of this course is to survey concepts in textile electronics including devices (communication, sensors, energy storage, digital processing) and use cases (military, health, wellness, infotainment). Students will examine materials and processing methods used in textile electronic development. Finally, students will use entrepreneurial design concepts to fabricate a textile electronic system.

R: Masters level standing or Senior standing with GPA >3.25
Typically offered in Spring only

TE 533/TT 533/TTM 533 Lean Six Sigma Quality (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of Lean Six sigma methods to improve product or process.

Prerequisite: ST 361 and ST 371, or equivalent
Typically offered in Spring only

TE 540/TE 440 Textile Information Systems Design (4 credit hours)
Textile information system design, real-world constraints. Principles of hardware, software, security and ethics issues. Emphasis on solving a real world problem. Credit will not be given for both TE 440 and TE 540.

Prerequisite: C- or better in TE 110 and JR standing
Typically offered in Fall only

TE 550 Clothing Comfort and Personal Protection Science (3 credit hours)
The course presents scientific principles for characterization and development of comfortable and/or protective textiles and clothing. Properties associated with human tactile response, thermal comfort and heat stress are emphasized. Inherent issues of balancing comfort versus protection are illustrated by research studies on performance garments or protective clothing systems. Methods and standards for evaluating comfort and protective performance range from bench level instruments to system level tests for ensembles using instrumented manikins, human clothing wear trials, and physiological tests.

R: Graduate Standing or Permission of Instructor
Typically offered in Fall only

TE 561/TT 561 Human Physiology for Clothing and Wearables (3 credit hours)
This course will provide students with the knowledge of scientific principles on the interactions between textiles and the human body. The students will learn some basics of human physiology, specifically as it relates to the interactions of the human with clothing and other related body worn products (protective wear, e-textile products and sensors). An important part of this course will focus on the thermal strain of humans when being active and wearing (protective) clothing. As the thermal heat balance is an important part of this course, students will learn to do a basic thermal analysis and computation of the human heat balance, including the influence of clothing. Also test and evaluation methods to assess clothing performance will be addressed on thermal aspects as well as addressing other ergonomics aspects of clothing, such as restriction of movement, visual and auditory aspects.

R: Graduate Standing or Permission of Instructor
Typically offered in Fall only

TE 562/OR 562/ISE 562 Simulation Modeling (3 credit hours)
This course concentrates on design, construction, and use of discrete/continuous simulation object-based models employing the SIMIO software, with application to manufacturing, service, and healthcare. The focus is on methods for modeling and analyzing complex problems using simulation objects. Analysis includes data-based modeling, process design, input modeling, output analysis, and the use of 3D animation with other graphical displays. Object-oriented modeling is used to extend models and enhance re-usability.

Typically offered in Spring only

TE 565/TMS 565 Textile Composites (3 credit hours)
Fiber architecture of textiles used for composites. Manufacturing processes and geometric quantification. Basic analysis for predicting elastic properties. Interrelationship of elastic properties and geometric quantities. Failure criteria for these materials.

Prerequisite: MA 341, MAE 206
Typically offered in Fall only

TE 566/BME 566/TE 466/BME 466 Polymeric Biomaterials Engineering (3 credit hours)
In-depth study of the engineering design of biomedical polymers and implants. Polymeric biomaterials, including polymer synthesis and structure, polymer properties as related to designing orthopedic and vascular grafts. Designing textile products as biomaterials including surface modification and characterization techniques. Bioresorbable polymers.

Prerequisite: PY 208 and (TE 200 or CH 220 or CH 221 or CH 225) and (MAE 206 or CE 214)
Typically offered in Fall only

TE 570/PY 570 Polymer Physics (3 credit hours)
Polymer microstructures, polymer solutions, polymer physical states (including amorphous polymers, crystalline polymers, polymer melts, melting of polymers, glass-transition, and other transitions), polymer blends, polymer mechanical properties, polymer viscoelasticity and flow, multicomponent polymer systems, and modern polymer topics. The physics of polymer fibers. Graduate standing or permission of instructor.

Typically offered in Fall only

TE 589/TMS 589/TC 589 Special Studies In Textile Engineering and Science (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

TE 601 Seminar (1 credit hours)
Typically offered in Fall and Spring

TE 630 Independent Study (1-3 credit hours)
Typically offered in Fall, Spring, and Summer

TE 676 Special Projects (1-3 credit hours)
Typically offered in Spring only

TE 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

TE 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TE 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TE 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Fall and Spring

TE 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TE 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis. Credits arranged

Prerequisite: Master's student
Typically offered in Fall only

Textile Materials Science (TMS)

TMS 211 Introduction to Fiber Science (3 credit hours)
Properties of fibers are related to their classification, chemical structure, type and origin- which helps with their identification and classification. Covered in this course are principles of fiber formation and the physical behaviors of fibers (including their mechanical, thermal, optical, frictional, electrical, and moisture management properties), and methods of measuring the physical properties of fibers. Relationships between polymer structure, fiber properties and utilization are explored. Also, students are introduced to tools that will help them reflect on how problems related to fiber science are solved.

Prerequisite: MT 105 or TT 105 or PCC 101; Corequisite: MA 131 or MA 141
GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

TMS 212 Yarn and Fabric Formation and Properties (2 credit hours)
The development of products from textile and fibrous materials is a critical component of new product development in many industries, including textiles, retail, plastics, composites, transporations, and architecture. This course provides the technical information required for scientists to understand how textile and fiber-based products are manufactures, with a practical view to cmbining the new knowledge with a molucular level understanding of fibers for unique new product development.

Prerequisite: TMS 211
Typically offered in Fall only

TMS 214 Yarn and Fabric Formation and Properties Lab (1 credit hours)
The development of products from textiles and fibrous materials is a critical component of new product development in many industry. This laboratory course provides hands-on exercises and demonstrations of key textile and fiber-based products are manufactured.

Prerequisite: TMS 212
Typically offered in Fall only

TMS 492 Special Topics in Textile Materials Science (1-3 credit hours)
Presentation of material not normally available in regular course offerings or offering of new courses on a trial basis. Credits and content determined by faculty member in consultation with the Department Head.

Typically offered in Fall and Spring

TMS 500 Fiber and Polymer Microscopy (3 credit hours)
Art and science of light and electron microscopy; theoretical and practical aspects of visibility, resolution and contrast. Laboratory practice in assembling, testing and using various microscopes and accessories in analyzing, describing and identifying unoriented and oriented crystalline or amorphous materials. Laboratory emphasis on study of fibers and polymers through transmission microscopy with polarized light.

Prerequisite: MA 242, PY 208, TC 203
Typically offered in Fall only

TMS 521/TT 521 Filament Yarn Production Processing and Properties (3 credit hours)
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperatures, twist, false twist and various bulking processes. Yarn structures and properties required for stretch and molded fabrics. Independent laboratory and critical literature review in general area of filament yarn processing, properties and test methods. credit not allowed for both TT 521 and TT 425

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TMS 565/TE 565 Textile Composites (3 credit hours)
Fiber architecture of textiles used for composites. Manufacturing processes and geometric quantification. Basic analysis for predicting elastic properties. Interrelationship of elastic properties and geometric quantities. Failure criteria for these materials.

Prerequisite: MA 341, MAE 206
Typically offered in Spring only

TMS 589/TC 589/TE 589 Special Studies In Textile Engineering and Science (1-4 credit hours)
New or special course on developments in textile engineering and science. Specific topics and prerequisites identified vary. Generally used for first offering of a new course.

Prerequisite: Senior standing or Graduate standing
Typically offered in Fall, Spring, and Summer

TMS 676 Special Projects (1-3 credit hours)

TMS 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 690 Master's Exam (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 695 Master's Thesis Research (1-9 credit hours)
Thesis research

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TMS 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall and Spring

TMS 761 Mechanical and Rheological Properties Of Fibrous Material (3 credit hours)
In-depth study of the stress-strain, bending, torsional, dynamic and rheological behavior of natural and man-made fibers. Presentation and discussion of theoretical relations and advanced techniques.

Prerequisite: MA 301
Typically offered in Spring only

TMS 762 Physical Properties Of Fiber Forming Polymers, Fibers and Fibrous Structures (3 credit hours)
Experimental results and theoretical considerations of physical properties of fibers and fiber-forming polymers. Electrical, thermal, optical, frictional and moisture properties of these materials. Influence of chemical and molecular fine structure on these properties.

Prerequisite: PY 208
Typically offered in Spring only

TMS 763/MSE 763 Characterization Of Structure Of Fiber Forming Polymers (3 credit hours)
Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state. Characterization methods include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance.

Prerequisite: Graduate standing
Typically offered in Fall only

Textile Technology (TT)

TT 105 Introduction to Textile Technology (3 credit hours)
Introduction to Textile and Apparel, Technology and Management. Structures and production methods for fabrics, yarn, and fibers. Introduction to the nature of polymers and the characteristics of polymers which make them useful for producing fibersthat are practically and aesthetically desirable. Design of end products as well as fundamental economic and supply chain issues.

Typically offered in Fall, Spring, and Summer

TT 221 Yarn Production and Properties I (2 credit hours)
The techniques available for manufacturing yarns from staple fibers. A review of yarn numbering and fiber properties. The principles involved in opening, cleaning, blending, drafting, twisting and winding. Short and long staple spinning systems including a review of opening and cleaning lines, carding, draw frames, roving frames and different spinning machines. Filament yarn processing.

Prerequisite: TT 105 or MT 105; Corequisite: MA 131 or MA 141
Typically offered in Fall, Spring, and Summer

TT 252 Formation and Structure of Textile Fabrics (4 credit hours)
Fundamentals of the conversion of fibers and yarns into woven, knitted, and nonwoven fabrics, and fabrics' conversion systems. Introduction to woven, knitted and nonwoven fabric design structure. Structure, property, and performance relations of textile fabrics. Testing and evaluation of textile structures.

Prerequisite: TT 221 or TTM 106
Typically offered in Fall, Spring, and Summer

TT 305 Introduction to Nonwoven Products and Processes (3 credit hours)
Fiber web/nonwoven fabrics produced directly from fibers or their precursors. Physical and chemical nature of local bonding and fiber entanglement. Viable processes for producing these fabrics. Economic justification for process and production. Product/process interaction. Plant visits whenever possible.

Prerequisite: TMS 211 and (MA 131 or MA 141) and (PY 211 or PY 205 and 206); Corequisite: ST 311 or ST 370
Typically offered in Fall, Spring, and Summer

TT 327 Yarn Production and Properties (4 credit hours)
The processing of natural and synthetic, fibers and filaments into yarns. The impact of fiber selection and processing parameters on the quality of the yarn and subsequent products. Major processing routes for staple fibers and filaments together with recent developments in applicable technologies.

Prerequisite: (TMS 211 or TE 201) and (MA 231 or MA 241) and (PY 211 or (PY 205 and PY 206))
Typically offered in Fall only

TT 331 Performance Evaluation of Textile Materials (4 credit hours)
Standards, principles and effects of test conditions in measuring basic physical and mechanical properties of textile materials. Design of test and interpretation of test results in relation to end-use performance, product development, process control, research and development and other requirements.

Prerequisite: (ST 311 or ST 370) and (TT 327 or TE 301) and (PY 211 or(PY 205 and PY 206)) and (MA 231 or MA 241)
Typically offered in Fall and Spring

TT 341 Knitted Fabric Technology (3 credit hours)
Review of knitted fabric production techniques. Technology of more advanced weft and warp knitting. Jersey and rib fabric modification techniques, yarn knitability and productivity, yarns, creels, patterning and machinery developments, manufacture and properties of warp knit fabrics such as mesh, laid-in, weft insertion and plush. Quality measures, measurement and standards, defects and problem solving. Management of knitting operations.

Prerequisite: TT 327
Typically offered in Spring only

TT 351 Woven Products and Processes (3 credit hours)
Design and development of various woven textile products including their component properties, performance, requirements, structures, and methods of production. The primary objective of the course is to introduce students to various woven textile products, including those used in automotives, agriculture, construction, ETC. and stimulate understanding of their structure, performance requirements, and relevant manufacturing principles including braiding.

Prerequisite: (TT 221 or TT 327) and (PY 211 or (PY 205 and PY 206))
Typically offered in Spring only

TT 380/FTM 380 Management and Control of Textile and Apparel Systems (3 credit hours)
Management approaches, practices and basic economic considerations in the development, production and distribution of industrial and consumer textile and apparel products.

Prerequisite: FTM 217
Typically offered in Fall only

TT 401 Textile Technology Senior Design I (4 credit hours)
This is Part 1 of 2 for the Senior Capstone Design Course. Students work in cross-functional teams to research and solve real-world problems in fibers, polymers, and textile science utilizing their foundation skills in Textile Technology. TT 401 and TT 402 must be taken in the same academic year as the class is project and team dependent. Students will be required to meet outside the normal class times as well as expected to participate in various off-campus field trips and activities for successful completion of the project. Project sponsors will cover any transportation costs that are incurred. TT majors only.

Prerequisite: TT 331, Senior standing
Typically offered in Fall only

TT 402 Textile Technology Senior Design II (4 credit hours)
This is Part 2 of 2 for the Senior Capstone Design Course. Students work in cross-functional teams to research and solve real-world problems in fibers, polymers, and textile science utilizing their foundation skills in Textile Technology. TT 401 and TT 402 must be taken in the same academic year as the class is project and team dependent. Students will be required to meet outside the normal class times as well as expected to participate in various off-campus field trips and activities for successful completion of the project. Project sponsors will cover any transportation costs that are incurred. TT majors only.

Prerequisite: TT 401
Typically offered in Spring only

TT 404/TT 504/NW 504/NW 404 Introduction to Nonwovens Products and Processes (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.

Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall only

TT 405/TT 505/NW 505/NW 405 Advanced Nonwovens Processing (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.

Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206) , TT 305 or TT 404
Typically offered in Spring only

TT 407 Characterization Methods in Nonwovens (3 credit hours)
Fundamentals of methods used in evaluating properties and performance of nonwovens. Assessment of thermal, mechanical, moisture transport and barrier properties of nonwovens. Reliability and interpretation of test results.

Prerequisite: ST 311 or ST 370; and TT 305 or TT 404
Typically offered in Spring only

TT 408/TT 508/NW 508/NW 408 Nonwoven Product Development (3 credit hours)
Fundamentals of nonwoven product development. In-depth knowledge of the materials, processes and nonwovens products. Design of a set of experiments intended for product development. Students work in teams to design, fabricate and evaluate nonwoven products.

Prerequisites: TT 405 and TT 407
Typically offered in Spring only

TT 431 Quality Management and Control In Textile Manufacturing (3 credit hours)
Principles of quality and process management and control in textile/apparel manufacturing with emphases in quality management systems, quality costs, statistical control chart procedures, process capability, acceptance sampling, and optimal process and product design and improvement methods.

Prerequisite: TT 331
Typically offered in Spring only

TT 451/TT 551 Advanced Woven Fabric Design (3 credit hours)
Design and production requirements for highly specialized woven fabric structures. The laboratory activities will include a project on design from concept to final production and finishing.

Prerequisite: (TT 252 or TT 351) and Senior Standing
Typically offered in Fall only

TT 470 Jacquard Woven Fabric Design (3 credit hours)
This course is dedicated to the study of Jacquard woven fabric design and structural technology through the use of CAD as both an aesthetic and technical tool, and will culminate in each student producing a unique fabric collection based upon his/her developed area of interest. Jacquard design for many different end uses is addressed, from art fabrics to unique specialty products. A field trip in this course will require personal transportation.

Prerequisite: TT 252, TT 371
Typically offered in Fall only

TT 480/FTM 480 Operations Management Decisions for Textiles (3 credit hours)
Quantitative techniques for decision making and management in the textile complex. Applications include vendor selection, plant location, retail inventory management, forcasting demand, project management, and logistics planning. Techniques covered include simulation, PERT/CPM, mathematical modeling.

Prerequisite: TT/FTM 380 and ACC 210 and ST 311 or ST 370 and ((MA 131 and 132) or MA 141)
Typically offered in Fall only

TT 481 Design and Technology of Technical Textiles (3 credit hours)
Performance requirements of various technical textiles. Underlying principles of design, application, manufacture, and evaluation of fibrous structures intended to meet specific end-use requirement.

Prerequisite: TT 305, TT 341 and TT 351
Typically offered in Fall only

TT 485/FTM 485 Textile Computer Integrated Enterprise (3 credit hours)
Survey of information technology in textile and apparel industries. Topics discussed include: computer aided design (CAD); computer aided manufacturing (CAM); computer aided engineering (CAE); material handling systems; automation and robotics; logistics and warehousing systems; retail product tracking, and Internet resources.

Prerequisite: TT/FTM 380
Typically offered in Fall only

TT 486/FTM 486 Supply Chain Management in the Textile Industry (3 credit hours)
Study of the operations necessary to produce and distribute a product, starting with the procurement of the raw material used in making the goods and ending with the delivery of the finished product. Topics covered include approaches to solving problems in manufacturing, sourcing, transportation logistics, and retail operations within the Integrated Textile Complex. Credit cannot be given for both TAM486 and MT386.

Prerequisite: TT/FTM 380
Typically offered in Spring only

TT 499 Textile Senior Project (4 credit hours)
This is a project based course to be taken in the last semester of the Senior year. In this capstone course the students work in cross-functional teams to research and solve applied problems in textile related fields. The results of the projects will be presented formally at the end of the semester. Course should be taken in the last semester of the Senior year. It cannot be substituted by other project courses

Prerequisite: Senior standing
Typically offered in Fall and Spring

TT 500 Understanding the Textile Complex (3 credit hours)
This course provides an overview of product development, processing, managing, financing, etc., for the textile industry. It is designed to give new graduate students basic preparations for more advanced, required textile courses. Students will also gain insight into the research being conducted within the College of Textiles.

Prerequisite: Graduate standing
Typically offered in Fall only

TT 503/NW 503 Materials, Polymers, and Fibers used in Nonwovens (3 credit hours)
Fundamentals of raw material used in nonwoven processes. Raw material production, chemical and physical properties of nonwoven raw materials and assessment of material properties. Introduction of structure/property relationships for these materials and how these relationships influence end use applications.

Prerequisite: MA 141, PY 205, PCC 203
Typically offered in Fall and Spring

TT 504/NW 504/NW 404/TT 404 Introduction to Nonwovens Products and Processes (3 credit hours)
This course introduces the fundamentals of nonwoven structures, process, and products. It provides performance criteria, raw materials, manufacturing methods, and market outlooks of major nonwoven application segments including hygiene, wipes, filters, medical, automotive, and geotextile. Emphasis is placed on building basic understandings of process/structure/property relationship in nonwoven product and the economic justification for process and production.

Prerequisite: (MA 131 or 141), PY 205; Corequisite: TT 503
Typically offered in Fall and Spring

TT 505/NW 505/NW 405/TT 405 Advanced Nonwovens Processing (3 credit hours)
Mechanisms used in the production of nonwoven materials. Design and operation of these mechanisms. Process flow, optimization of process parameters, influence of process parameters on product properties.

Prerequisite: MA 231 or MA 241, PY 211 or (PY 205 and PY 206) , TT 305 or TT 404
Typically offered in Spring only

TT 507/NW 507 Nonwoven Characterization Methods (3 credit hours)
Fundamentals of methods used in evaluating properties and performance of nonwovens. Assessment of thermal, mechanical, moisture transport and barrier properties of nonwovens. Reliability and interpretation of test results.

Prerequisite: ST 361, Corequisite: TT/NW 505
Typically offered in Spring only

TT 508/NW 508/NW 408/TT 408 Nonwoven Product Development (3 credit hours)
Fundamentals of nonwoven product development. In-depth knowledge of the materials, processes and nonwovens products. Design of a set of experiments intended for product development. Students work in teams to design, fabricate and evaluate nonwoven products.

Prerequisites: TT 405 and TT 407
Typically offered in Fall and Spring

TT 520 Yarn Processing Dynamics (3 credit hours)
Principles and practice involved in modern yarn and manufacture; including machine-fiber interactions occurring during different processing stages. Not normally for credit for undergraduate textile majors.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Spring

TT 521/TMS 521 Filament Yarn Production Processing and Properties (3 credit hours)
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperatures, twist, false twist and various bulking processes. Yarn structures and properties required for stretch and molded fabrics. Independent laboratory and critical literature review in general area of filament yarn processing, properties and test methods. credit not allowed for both TT 521 and TT 425

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TT 530/TTM 530 Textile Quality and Process Control (3 credit hours)
Quality control and improvement methods for textile processes and products including quality systems, statistical control chart procedures, process capabilities, acceptance sampling plans, textiles process and product designs, on-line and off-line control systems and specific quality factors governing textile products and processes and their variabilities.

Prerequisite: TT 420, Corequisite: ST 511 or ST 515
Typically offered in Spring only

TT 532 Evaluation of Biotextiles (3 credit hours)
Evaluation of the performance of biotextiles and medical polymers in biological and microbiological environments, with an emphasis on "in vitro" and "in vivo" techniques for testing the biocompatibility and biostability of implantable biomedical products. Related issues will deal with quality assurance systems, inspection and sampling plans, ISO certification, GMP's, reference materials and organisms, and the use of accelerated tests an animal trials so as to meet regulatory requirements.

Prerequisite: ZO 160, TC 203, TMS 211, CH 220
Typically offered in Fall only

TT 533/TTM 533/TE 533 Lean Six Sigma Quality (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of Lean Six sigma methods to improve product or process.

Prerequisite: ST 361 and ST 371, or equivalent
Typically offered in Spring only

TT 535/TTM 535 Research Methods and Management (3 credit hours)
This course provides students with an understanding and appreciation of the basic principles of research methods when using qualitative, quantitative or a mixed methods approach. This course will provide guidance to students in conducting their thesis project and cover all aspects of a thesis project, including but not limited to the first three chapters, defining the problem, conducting and writing the literature review, use of theories and a conceptual framework, data collection and analyses, ethical considerations and IRB approval, and the Electronic Thesis Dissertation requirements. Students will be assigned additional readings and learning activities that will expand the understanding of the research process. This course is geared to students who have narrowed down their research topic in collaboration with their committee chair.

Restriction: TTM Students, FPS Students, or a Master's of Science in Textiles, Textile Engineering, or Textile Chemistry. Graduate standing or permission of instructor.
Typically offered in Fall and Spring

TT 549 Warp Knit Engineering and Structural Design (3 credit hours)
Engineering analysis of tricot and raschel machinery. Design of yarn let-off and fabric take-up mechanisms. Studies of fabric production techniques and quality control systems. Theory of production optimization and the properties of fabrics. Complexgeometrical loop models and their application.

Prerequisite: TT 443
Typically offered in Spring only

TT 550 Production Mechanics and Properties of Woven Fabrics (3 credit hours)
Interrelation between mechanics of production and mechanical properties of woven fabric; unit operations required to prepare yarns for weaving and the mechanism employed in weaving; fabric structure, geometry and mechanical properties; designing forspecific fabrics properties. Not normally for credit for undergraduate textiles majors.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TT 551/TT 451 Advanced Woven Fabric Design (3 credit hours)
Design and production requirements for highly specialized woven fabric structures. The laboratory activities will include a project on design from concept to final production and finishing.

Prerequisite: (TT 252 or TT 351) and Senior Standing
Typically offered in Fall only

TT 553 Formation and Structure of Woven and Knitted Fabrics (3 credit hours)
The interrelation between the mechanics of production and mechanical properties of woven and knitted fabrics; unit operations required to prepare yams for weaving and knitting and mechanisms employed in weaving and knitting; fabric structure, geometry and mechanical properties; designing for specific fabric properties. Students will not be allowed credit for TT 553 and (TT 541, TT 549, and TT 550).

Typically offered in Spring only

TT 561/TE 561 Human Physiology for Clothing and Wearables (3 credit hours)
This course will provide students with the knowledge of scientific principles on the interactions between textiles and the human body. The students will learn some basics of human physiology, specifically as it relates to the interactions of the human with clothing and other related body worn products (protective wear, e-textile products and sensors). An important part of this course will focus on the thermal strain of humans when being active and wearing (protective) clothing. As the thermal heat balance is an important part of this course, students will learn to do a basic thermal analysis and computation of the human heat balance, including the influence of clothing. Also test and evaluation methods to assess clothing performance will be addressed on thermal aspects as well as addressing other ergonomics aspects of clothing, such as restriction of movement, visual and auditory aspects.

R: Graduate Standing or Permission of Instructor
Typically offered in Fall only

TT 570 Textile Digital Design and Technology (3 credit hours)
This course focuses on design of textile products balancing industry and creative foci. Students will study a range of industry focused technologies and techniques essential to creation of textile products in a technology intensive environment. Basics of textile product design and relevant technologies will be covered along with methods and techniques to improve commercial textile product design process. Students will research in-depth a topic related to textile product design, and present their research in an oral format.

Prerequisite: Graduate standing
Typically offered in Fall only

TT 571 Professional Practices in Textile Design and Technology (3 credit hours)
This course builds on the concepts introduced in TT 570 with increased focus on professional practice and methods. Focus on advanced textile product design topics incorporating an industry focus and utilizing commercial technologies. Students willinvestigate in depth a textile product design industry application, technique or method of interest using individual and tam based strategies. Topics include advanced study of textile product design concepts, techniques and preparation for professional competitions, displays and conferences.

Prerequisite: TT 570
Typically offered in Spring only

TT 581 Technical Textiles (3 credit hours)
Performance requirements of various technical textiles. Underlying principles of design and manufacturing of fibrous structures to meet specific needs in mechanical and other behaviors.

Prerequisite: TT 520 or TT 521, and TT 550
Typically offered in Fall only

TT 591 Special Studies in Textile Technology (1-4 credit hours)
Special Studies in Textile Technology to fulfill needs not covered by current offering. Student and faculty required to submit topics to be covered to director of graduate programs within first week of semester.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TT 601 Seminar (1 credit hours)
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.

Typically offered in Fall and Spring

TT 630 Independent Study in Textile Technology (1-3 credit hours)
Problems of specific interest in textile technology. Preparation of report, in format suitable for publication required. One-page outline signed by advisor must be submitted to director of graduate programs within first week of semester. A maximumof 3 credit hours will be allowed towards Master of Textiles Degree. No credit is allowed towards MS (Textiles).

Typically offered in Fall, Spring, and Summer

TT 676 Special Projects Textile Technology (1-3 credit hours)
Typically offered in Fall and Spring

TT 685 Master's Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment and evaluate the student upon completion of the assignment.

Prerequisite: Master's student
Typically offered in Fall only

TT 690 Master's Examination (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall and Spring

TT 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TT 695 Master's Thesis Research (1-9 credit hours)
Thesis Research

Prerequisite: Master's student
Typically offered in Spring only

TT 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TT 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student
Typically offered in Spring only

TT 896 Summer Dissert Res (1 credit hours)

Textile Technology Management (TTM)

TTM 106 Yarn Formation, Classification and Numbering Systems (1 credit hours)
The course addresses techniques available for manufacturing staple and filament yarns, classification of yarn types, and processes involved in manufacturing staple and filament yarns. The course covers hands-on calculations and measurements of yarn numbering systems including direct and indirect systems.

Prerequisite: TT 105; Corequisite: MA 131 or MA 141 (Calculus I)
Typically offered in Fall and Spring

TTM 501 Textile Enterprise Integration (3 credit hours)
Discussion of philosophy, strategy and technology of enterprise integration for textile manufacturing. Survey of enabling technologies such as computer-aided design; computer-aided manufacturing; material handling systems; information systems for control, supervision and planning; and internet resources.

Prerequisite: Graduate standing, Background in textile manufacturing.
Typically offered in Fall only

TTM 510 Apparel Technology Management (3 credit hours)
Role of the apparel complex in manufacturing and supplying products on demand to meet the quality and performance of the global customer. The critical juxtaposition of the textile supply together with retail demand studied to understand constraintson manufacturing capacities and elasticities.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall only

TTM 515 Apparel Production (3 credit hours)
Concepts and practices for the production of apparel items, beginning with development of basic fit blocks and extending through the reation of stylized garments using pattern engineering techniques, supported by computerized pattern development.

Typically offered in Fall only

TTM 517 Advanced Computer-Aided-Design for Fashion (3 credit hours)
Exploration of industry design software for apparel and other sewn products. U4ia visual design software, 3D to 2D pattern generation software, Gerber Accumark or Lectra pattern design programs, Adobe Illustrator and Photoshop, and other programs used by the industry to create, market and/or visualize products will be taught. Peripheral equipment essential to the design and visualization process will be included.

Typically offered in Spring only

TTM 530/TT 530 Textile Quality and Process Control (3 credit hours)
Quality control and improvement methods for textile processes and products including quality systems, statistical control chart procedures, process capabilities, acceptance sampling plans, textiles process and product designs, on-line and off-line control systems and specific quality factors governing textile products and processes and their variabilities.

Prerequisite: TT 420, Corequisite: ST 511 or ST 515
Typically offered in Spring only

TTM 533/TE 533/TT 533 Lean Six Sigma Quality (3 credit hours)
Systematic approach (Lean Six Sigma philosophy) for improving products and processes. Defining the improvement opportunity, measurement system analysis, data collection, statistical analysis, design of experiment (DOE) methods, and statistical process control (SPC) methods. Application of Lean Six sigma methods to improve product or process.

Prerequisite: ST 361 and ST 371, or equivalent
Typically offered in Spring only

TTM 535/TT 535 Research Methods and Management (3 credit hours)
This course provides students with an understanding and appreciation of the basic principles of research methods when using qualitative, quantitative or a mixed methods approach. This course will provide guidance to students in conducting their thesis project and cover all aspects of a thesis project, including but not limited to the first three chapters, defining the problem, conducting and writing the literature review, use of theories and a conceptual framework, data collection and analyses, ethical considerations and IRB approval, and the Electronic Thesis Dissertation requirements. Students will be assigned additional readings and learning activities that will expand the understanding of the research process. This course is geared to students who have narrowed down their research topic in collaboration with their committee chair.

Restriction: TTM Students, FPS Students, or a Master's of Science in Textiles, Textile Engineering, or Textile Chemistry. Graduate standing or permission of instructor.
Typically offered in Spring only

TTM 545 Weft and Warp Knit Engineering and Structural Design (3 credit hours)
This class is for both designers, engineers, and technicians for garment applications and machine technologies, to design and create a wide range of products using non-traditional materials and techniques, with the options of knitting in both two and three dimensions. Applications can be but are not limited to sports, medicine, Industrial, electronic and entertainment, transportation, interior design, and furniture.

Typically offered in Fall only

TTM 561 Strategic Technology Management in the Textile Complex (3 credit hours)
Management approaches and strategies for forecasting, planning, creating, and implementing technology changes in textile industry complex undergoing rapid market place and global competitive changes.

Prerequisite: Graduate standing or PBS status
Typically offered in Spring only

TTM 573 Management of Textile Product Development (3 credit hours)
The course focuses on an integrated approach to new product design, development and marketing of textile products. This integrated approach includes a) innovation strategy and opportunity identification, b) the design process for textile products, c) market launch, and d) managing innovation. The course include diverse textile end-uses, including apparel, home textiles, transportation textiles, and medical textiles. Trends in textile product development are reviewed. The dynamics of business analysis and strategy, design prototypes, and product analysis and recommendation are analyzed.

Prerequisite: Graduate standing
Typically offered in Spring only

TTM 579 Textile Design Collection Studio (6 credit hours)
Execution of creative projects addressing textile design problems through synthesis of background research and investigation, and knowledge from previous courses; preparation of work for portfolio, juried exhibition and participation in industry based competitions. Professional textile design practices including advanced portfolio development concepts and presentation, development of textile collections for specified end uses with emphasis on ideation, refinement and design development, and visual communication. FTD-TD ABM and TATM graduate students only.

Prerequisite: FTD 374, FTD 475, FTD 476
Typically offered in Spring only

TTM 580 Consumer Perspectives in Fashion (3 credit hours)
Introduction of concepts and theories related to consumer behavior. Analysis of apparel and textile consumers and their decision making processes as well as internal and external influencing factors. Application of consumer behavior models to investigate consumer behaviors pertaining to textile and apparel products through individualized research projects.

Typically offered in Fall only

TTM 581 Global Textile and Apparel Business Dynamics (3 credit hours)
An overview of the economic, competitive, tchnological and market dynamics of the international textile and apparel industries. Trends in demand, output and trade are reviewed. The dynamic forces shaping and transforming the industry internationally are analyzed. Patterns of change at the global, regional, national and company level are explained and the outlook for the industries is considered.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall and Summer

TTM 582 Global Textile Brand Management and Marketing (3 credit hours)
The course provides an understanding of the global textile brand management and marketing environments, global markets, and marketing programs and organizations. Specific topics include a) the economic, social, political/legal, and cultural environments; b) global textile market opportunities and challenges; c) global textile and apparel marketing strategies, and d) creation and management of global textile and apparel marketing programs. Credit will not be allowed for both TAM 482 and TAM 582. Graduate standing.

Typically offered in Fall only

TTM 583 Strategic Planning for Textile Firms (3 credit hours)
Elements of competitive strategy and planning methods within the textile complex with emphasis on the concepts of strategy in a mature industry, defining business in a global industry, resource allocation through strategic planning methods and implementing strategy in a single business and multi-business firms.

Prerequisite: Graduate standing
Typically offered in Fall only

TTM 587 Advanced Fashion Collection Studio (6 credit hours)
Graduate level fashion product design. Design and production of a "collection" using various methods of generating patterns for garments, such as flat pattern, draping CAD design techniques. Relationship of body configuration and fabrication to garment design. Emphasis on ideation, creativity, communication, fit quality and exhibition of a fashion collection. Work culminates in a fashion show or static exhibition. Restricted to TATM majors.

P: FTM 315,317, and 318 or FTD215, 216, and 321
Typically offered in Fall and Spring

TTM 588 Global Perspectives in Textiles Supply Chain Management (3 credit hours)
Study and analysis of global textile supply chains. Field trips to textile related companies and organizations are required. Students will conduct a research project on global supply chain issues. Course taught off campus for non US global perspectives. Students may not take this course more than once for the same global perspective.

TTM 591 Special Studies in Textile Technology Management (1-4 credit hours)
Special Studies in Textile and Apparel, Technology and Management to fulfill needs not covered by current offerings. Student and faculty required to submit topics to be covered to director of graduate programs within first week of semester.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TTM 601 Seminar (1 credit hours)
Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems.

Typically offered in Fall and Spring

TTM 630 Independent Study in Textile Technology Management (1-3 credit hours)
Problems of specific interest in textile and apparel technology. Preparation of report, in a format suitable for publication required. One-page outline signed by advisor must be submitted within first week of semester.

Typically offered in Fall, Spring, and Summer

TTM 632 Special Studies in Textile Product Development (1-6 credit hours)
Preq: Graduate standing or PBS student. This course is an Independent Study in Textile Product Development to fulfill needs not covered by current course offerings. Student and faculty are required to submit the topic to be covered to the graduate administrator within the first week of the semester. Either a paper or a presentation of a body of work will be the outcome of this effort.

Prerequisite: Graduate standing or PBS status
Typically offered in Fall, Spring, and Summer

TTM 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall and Spring

TTM 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TTM 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TTM 710 Textile Technology Management (3 credit hours)
The course will discuss economic and technical aspects of managing technology in the textile complex. It will explain how technological change can be planned and thus managed, and it will address the required framework for forecasting, planning, creating, and implementing technological change. Cases of technological change in the textile complex will be discussed.

Requirement: 18TTMPHD
Typically offered in Fall only

TTM 731 Decision Models and Applications in Textile and Apparel Management (3 credit hours)
This course provides students with an overview of data decision models used in the textile and apparel industry, along with skills to apply them in real-world decision processes. Published academic papers and case studies will augment the teaching and learning in international trade, supply chains, manufacturing processes, quality, marketing, retail and distribution.

Restriction: TTM PhD
Typically offered in Spring only

TTM 750/FPS 750 Advances in Fabric Formation, Structure, and Properties (3 credit hours)
The course covers different aspects of the processing of yarns to products (braided, knitted, woven, and their composites) and the interrelation between the production mechanics and structure, geometry and properties of fiber assembly. Topics in the field are assigned and each student is expected to thoroughly study the topics and write critical papers based on structured assignments and specific questions. Conduct projects from concept to fabric formation, analyses, and evaluation.

Prerequisite: TT 550 or TT 551 (or TT 451) or equivalent
Typically offered in Spring only

TTM 761 Supply Chain Management and Information Technology (3 credit hours)
Working knowledge of management concepts and information technologies to design and manage supply chain operations in textile complex. Deals with markets and operations distributed geographically and institutionally.

R: Graduate Students Only
Typically offered in Spring only

TTM 785 Doctoral Research Methods (3 credit hours)
The course in research methods examines contributions to knowledge among the interdisciplinary streams of inquiry that inform global management in textiles and apparel. The course requires active discourse among students regarding: philosophy of science, dominant research paradigms, assumptions of quantitative and qualitative research methods, application of qualitative and quantitative research methods to areas including but not limited to: product development, technology management, supply chain management, textile economics & trade, marketing strategy and consumer behavior. Students are expected to develop particular understanding of the methods commonly applied in their area of interest.

Requirement: 18TTMPHD
Typically offered in Fall only

TTM 791 Advanced Special Studies in Textile Technology Management (1-4 credit hours)
Advanced Special Studies in Textile Technology Management to fulfill needs not covered by current offerings. Students and faculty are required to submit topics to be covered to the graduate administrator before the start of semester.

Prerequisite: Doctoral Student
Typically offered in Fall, Spring, and Summer

TTM 801 Seminar (1 credit hours)
Typically offered in Fall and Spring

TTM 830 Independent Study (1-3 credit hours)
Typically offered in Fall and Spring

TTM 876 Special Project TTM (1-3 credit hours)
Typically offered in Fall only

TTM 885 Doctoral Supervised Teaching (1-3 credit hours)
Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student
Typically offered in Fall only

TTM 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TTM 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

TTM 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TTM 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

TTM 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall and Spring

Textiles (T)

T 101 Strategies for Success in the Wilson College of Textiles (1 credit hours)
Introduction to topics related to the Wilson College of Textiles, all textile curricula, advising, academic skills, high impact activities, diversity, career preparation, campus resources and key Wilson College personnel. Students will not receive credit for both USC 301 and T 101.

Typically offered in Fall and Spring

T 102 Introduction to Product Evolution (2 credit hours)
Students explore the new product development (NPD) process through analysis of case studies of how textile products are designed and developed for a variety of sectors of our economy, including automotive, medical, industrial, furniture, and clothing. Students develop critical thinking skills as they read a variety of texts and respond using several forms of writing techniques.

Typically offered in Fall and Spring

T 104 Fabric of Success and Career Readiness (1 credit hours)
This course will provide students with the knowledge and resources needed to effectively identify, plan, and achieve their career interests and goals. Participants will develop the career-readiness skills that employers seek in new hires, thus allowing them to be better prepared for and successful in their future internship and job searches.

Restriction: Wilson College of Textiles Students with 30+ hours completed at NC State or have junior status
Typically offered in Fall and Spring

T 200 Introduction to Textiles (3 credit hours)
Survey of textiles including technical and economic history of the industry; physical and chemical processes involved in producing textile products from raw materials; unique aesthetic, physical and chemical properties of textiles and how these properties are determined by raw materials and production processes; and influence of properties of textile materials on their utilization and performance. Not open to students required to take TT 105; open to transfer students

Typically offered in Fall, Spring, and Summer

T 491 Honors Seminar in Textiles (1 credit hours)
A seminar on current university and industrial research in the field of textiles.

Prerequisite: By invitation into Honors Program in Textiles
Typically offered in Spring only

T 493 Internship in Textiles (1-3 credit hours)
Students enrolled in T 493 will complete a professional internship experience in a supervised textiles-related role. Students must acquire their own internship prior to enrolling in the course.

R: Textiles Students Only, Departmental Approval Required
Typically offered in Fall, Spring, and Summer

T 495 International Collaboration in Textiles Research (1-6 credit hours)
Directed undergraduate research in Textiles and/or Apparel related areas that requires collaboration with students at an institution abroad. The research project is structured as an international team project in an applied field that allows students in different countries to work together using various communication tools. Students shall arrange international contacts and provide a written proposal of the project to the undergraduate administrator or course coordinator prior to registration. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: GPA of 2.75 or better and JR standing
Typically offered in Fall, Spring, and Summer

T 497 Independent Research in Textile Engineering, Chemistry and Materials Science I (1-3 credit hours)
Independent research in Textile Engineering, Chemistry and Materials Science topics through experimental, theoretical and literature studies. Written and oral reports required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: Junior standing in TECS; 2.8 GPA
Typically offered in Fall and Spring

T 498 Independent Research in Textile Engineering, Chemistry and Materials Science II (1-3 credit hours)
Independent research in Textile Engineering, Chemistry and Materials Science topics through experimental, theoretical and literature studies. Written and oral reports required. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Prerequisite: T 497
Typically offered in Spring only

Theatre (THE)

THE 103 Introduction to the Theater (3 credit hours)
Artistic, technical, historical, and literary areas of theater, including acting, directing, design, stagecraft, lighting, costuming, makeup, and criticism.

GEP Visual and Performing Arts
Typically offered in Fall and Spring

THE 203 Theory and Practice of Acting (3 credit hours)
Basic contemporary theories on acting, with practical application through classroom exercises. Role analysis, adaptation of voice and body to performance demands, and role development through various rehearsal activities.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

THE 223 Stagecraft (3 credit hours)
Fundamentals of scenery design, set construction, and related technical activities. Practical applications with use of design media and shop facilities. Required production participation in University Theater presentations.

Typically offered in Fall only

THE 293 Theater Practicum (1-6 credit hours)
Practical experience in one or more of the various areas of artistic and technical theater through active participation in Thompson Theater's play production program.

Typically offered in Fall, Spring, and Summer

THE 303 Stage Directing (3 credit hours)
Basic theory of directing and its application to theatrical production. Play reading, evaluation, casting procedure, staff organization, and rehearsal planning and practices. Laboratory productions of short plays.

Typically offered in Spring only

THE 334 Advanced Acting (3 credit hours)
Advanced methods in role preparation through exercises in concentration, imagination, sensory and emotional recall, and other Stanislavskian techniques. Analyses and critiques of plays and in-class performances.

Prerequisite: THE 203 or demonstrated competence in acting
Typically offered in Spring only

THE 340 African American Theatre (3 credit hours)
This course examines African American dramaturgy and its impact on American theatre. We will study plays from the early period, 1847-1938, and from the recent period, 1935-present. This course will investigate the thematic structure of each section of plays including family life, social protest, and religion. The course will also help students to better understand the social milieu that shaped the content of each play. THE 103 Intro to Theatre recommended prior to course.

GEP U.S. Diversity
Typically offered in Fall and Spring

THE 353 Fundamentals of Theatre Design (3 credit hours)
Fundamentals of Theatre Design provides a framework for the designer's artistic process and practical foundation for scenic, costume, and lighting design for the theatre. Students will learn design terminology, text and performance analysis, design development and presentation, design and production communication and collaboration. Recommended completion of THE 223 Stagecraft. Students may be required to provide their own transportation to and cover the cost of on- or off-campus performance events not to exceed $20.

Typically offered in Spring only

THE 398 Special Topics in University Theatre (1-3 credit hours)
Presentation of material normally not available in regular course offerings, or offerings of a new course on a trial basis.

Typically offered in Fall, Spring, and Summer

THE 433 Period Styles in Acting (3 credit hours)
Interpreting daily lives in earlier eras through reading, discussion, research, and performance. Plays of complex heightened language, in verse and prose, studied from perspective of character's daily lives and their relevance to contemporary performance skills. Scenes, monologues, and soliloquies rehearsed and performed.

Prerequisite: THE 203
Typically offered in Fall and Spring

Toxicology (TOX)

TOX 201 Poisons, People and the Environment (3 credit hours)
TOX 201 serves as an introduction to the fascinating world of chemical poisons and covers their numerous and varied effects on human health and the environment. We will learn how and why poisons have played an important history, how to critically evaluate the chemical risk information reported in the media, in addition to the underlying principles of the basic science of poisons.

GEP Natural Sciences
Typically offered in Fall, Spring, and Summer

TOX 400 Undergraduate Seminar in Toxicology (1 credit hours)
In this seminar course students will be exposed to different presenters each week who will speak on current topics in toxicology, presenting their research on that topic in a broader context. Specific topic areas will vary from semester to semester, but will always be relevant to environmental and molecular toxicology. Students will be expected to write two 1-2 page reflection essays over the course of the semester and participate in a current events in toxicology discussion forum.

Restriction: 17ETM Only
Typically offered in Spring only

TOX 401/TOX 501 Principles of Toxicology (4 credit hours)
Introduce students to the basic principles of toxicology. Will cover the history and scope of the field; absorption, distribution, metabolism and elimination of toxicants; types and mechanisms of toxic action; carcinogenesis; environmental toxicology as well as human and ecological risk assessment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160
Typically offered in Spring only

TOX 415 Environmental Toxicology and Chemistry (4 credit hours)
Environmental toxicology and chemistry including the sources, fate, and effects of chemicals in the environment. Emphasis on contemporary problems in human health and the environment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160 recommended
Typically offered in Fall and Spring

TOX 501/TOX 401 Principles of Toxicology (4 credit hours)
Introduce students to the basic principles of toxicology. Will cover the history and scope of the field; absorption, distribution, metabolism and elimination of toxicants; types and mechanisms of toxic action; carcinogenesis; environmental toxicology as well as human and ecological risk assessment.

Prerequisite: CH 220 or CH 221 or CH 225; BIO 181 or ZO 160
Typically offered in Spring only

TOX 515 Environmental Toxicology (4 credit hours)
Evaluation of the nature, distribution and significance of microchemical contamination. Emphasis on current, relevant problems.

Prerequisite: Two years of biology

TOX 595 Special Topics (1-6 credit hours)

TOX 601 Toxicology Seminar (1 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall and Spring

TOX 620 Special Problems (1-6 credit hours)
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, journal club and wildlife toxicology.

Prerequisite: Graduate standing
Typically offered in Fall, Spring, and Summer

TOX 660 Free Radicals In Toxicology (1 credit hours)
Introduction to the field of free radicals and their role in toxicology and health; chemical and physical properties of partially reduced oxygen intermediates and the natural biological defense mechanisms.

Prerequisite: BCH 451 and TOX 710
Typically offered in Fall only

TOX 688 Non-Thesis Masters Continuous Registration - Half Time Registration (1 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain half-time continuous registration to complete incomplete grades, projects, final master's exam, etc.

Prerequisite: Master's student
Typically offered in Spring only

TOX 689 Non-Thesis Master Continuous Registration - Full Time Registration (3 credit hours)
For students in non-thesis master's programs who have completed all credit hour requirements for their degree but need to maintain full-time continuous registration to complete incomplete grades, projects, final master's exam, etc. Students may register for this course a maximum of one semester.

Prerequisite: Master's student
Typically offered in Spring only

TOX 690 Master's Exam (1-9 credit hours)
For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TOX 693 Master's Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TOX 695 Master's Thesis Research (1-9 credit hours)
Thesis research.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TOX 696 Summer Thesis Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student
Typically offered in Summer only

TOX 699 Master's Thesis Preparation (1-9 credit hours)
For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student
Typically offered in Fall, Spring, and Summer

TOX 701 Fundamentals of Toxicology (3 credit hours)
The basis of toxic action at cellular and molecular levels covering the absorption, distribution, elimination and metabolism of toxicants; toxic action (acute toxicity, carcinogenesis, mutagenesis, organ toxicity, etc.); chemical classes of toxicants; and toxicity testing.

Prerequisite: BCH 451, Senior standing or Graduate standing
Typically offered in Fall only

TOX 704 Chemical Risk Assessment (1 credit hours)
Concepts and vocabulary of risk assessment. Risk assessment models and techniques used in cancer and non-cancer risk assessment and strategies for successful risk communications. Case studies of risk assessment and issues of current interest. Utilization of background in toxicology and statistics to examine a critical end-point in toxicological science, the quantitative risk assessment.

Prerequisite: TOX 701, a ST course

TOX 710 Molecular and Biochemical Toxicology (3 credit hours)
Fundamental understanding of biochemical, molecular and cellular mechanisms through which xenobiotics alter cellular homeostasis, produce toxicity and alter organ function. Current biochemical, molecular and cellular experimental approaches for study of biochemical mechanisms of toxicity.

Prerequisite: BCH 451; TOX 701
Typically offered in Spring only

TOX 715 Environmental Toxicology (3 credit hours)
Evaluation of fundamental processes relating fate and effects of chemicals in the environment. Emphasis on effects of pollutants on non-human species, environmental risk assessment and historically relevant incidents of environmental contaminants.

Prerequisite: Two years of biology
Typically offered in Fall only

TOX 725/CS 725/HS 725/SSC 725 Pesticide Chemistry (1 credit hours)
Chemical properties of pesticides including hydration and solvation, ionization, volatilization, lipophilicity, molecular structure and size, and reactivity and classification according to chemical description, mode of action or ionizability. Taughtduring the first 5 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: (CH 201 or CH 203) and (CH 221 or CH 225)
Typically offered in Spring only

TOX 727/CS 727/HS 727/SSC 727 Pesticide Behavior and Fate In the Environment (2 credit hours)
Sorption/desorption, soil reactivity, movement, volatilization, bioavailability, degradation and stability of pesticides in the environment. Taught during the last 10 weeks of semester. Drop date is last day of 3rd week of the minicourse.

Prerequisite: CS(HS,SSC,TOX) 725,SSC 200
Typically offered in Spring only

TOX 771/CBS 771 Cancer Biology (4 credit hours)
A comprehensive graduate course focusing on the molecular and cellular bases of cancer. Targets of oncogenic mutations will be discussed as well as their impact on cell proliferation, cell survival, and the invasion of normal tissues by tumorigeniccells. State-of-the-art technologies to detect oncogenic mutations and characterize transformed cells will be discussed as well as therapeutic strategies for the rational treatment of cancer.

Prerequisite: CBS 770
Typically offered in Fall only

TOX 795 Special Topics in Toxicology (1-6 credit hours)
Typically offered in Fall and Spring

TOX 801 Toxicology Seminar (1 credit hours)
Prerequisite: Graduate standing
Typically offered in Fall and Spring

TOX 820 Special Problems In Toxicology (1-6 credit hours)
Topics include responsibility in science, environmental fate of chemicals, developmental toxicology, lab rotations, Journal Club, and wildlife toxicology.

Prerequisite: Graduate standing
Typically offered in Fall and Spring

TOX 860 Free Radicals in Toxicology (1 credit hours)
Introduction to the field of free radicals and their role in toxicology and health; chemical and physical properties of partially reduced oxygen intermediates and the natural biological defense mechanisms.

Prerequisite: BCH 451 and TOX 710
Typically offered in Fall only

TOX 890 Doctoral Preliminary Examination (1-9 credit hours)
For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 893 Doctoral Supervised Research (1-9 credit hours)
Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 895 Doctoral Dissertation Research (1-9 credit hours)
Dissertation research.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

TOX 896 Summer Dissertation Research (1 credit hours)
For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student
Typically offered in Summer only

TOX 899 Doctoral Dissertation Preparation (1-9 credit hours)
For students who have completed all credit hour, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student
Typically offered in Fall, Spring, and Summer

U.S. Diversity (USD)

USD 295 U.S. Diversity Special Topics (1-3 credit hours)
Special topics course offering for the general education U.S. Diversity category.

GEP U.S. Diversity
Typically offered in Fall and Spring

University Scholars Program (USP)

USP 110 Humanities and Social Sciences Scholars Forum (0 credit hours)
Interdisciplinary seminar series with presentations by distinguished faculty members and experts drawn from technical, academic, business and government communities. Discussions of major public issues and topics of contemporary concern.

Prerequisite: Enrollment limited to participants in the University Scholars Program
Typically offered in Fall only

USP 111 Humanities and Social Sciences Scholars Forum (0 credit hours)
Interdisciplinary seminar series with presentations by distinguished faculty members and experts drawn from technical, academic, business and government communities. Discussions of major public issues and topics of contemporary concern.

Prerequisite: Enrollment limited to participants in the University Scholars Program
Typically offered in Spring only

USP 201 Great Decisions (1 credit hours)
Discussion and investigation of major issues in contemporary American foreign policy selected annually by the Foreign Policy Association through its Great Decisions Program. Must be participants in the University Scholars Program. Must have completed three semesters of the Scholars Forum (USP 110/111). Must have GPA of at least 3.25.

Prerequisite:3 semesters of USP 110/111; R: RS/CS students
Typically offered in Fall and Spring

USP 204 Readings Inspired By the Scholars Forum (1 credit hours)
Seminar course for upper class University Scholars who have completed three semesters of the Scholars Forum, with readings drawn from upcoming Scholars Forum themes.

Prerequisite:3 semesters of USP 110/111; R: RS/CS students
Typically offered in Fall and Spring

University Studies Course (USC)

USC 100 Transition into a Diverse Community (1 credit hours)
USC 100 is required for all Summer Start students. It is designed to assist freshmen in making an effective transition to the rigors of a large diverse research-focused university. The course is designed to provide students with the support and knowledge needed to address the academic and personal challenges as well as other transitional issues. This course will also help students understand how culture shapes identity. Classroom discussions, small group work, completion of StrengthsQuest, and an introduction to technological and other resources are all vital components of this course. Topics include: diversity, cultural awareness, StrengthsQuest, academic adjustment, college success, social adjustment, campus resources, and health.

GEP U.S. Diversity
Typically offered in Summer only

USC 101 Introduction to University Education I (1 credit hours)
Developmental and academic topics to assist students as they make well-informed decisions about majors. Topics include: transition issues between high school and college; community and diversity; major and career decision making; assessment of interests, skills, and values; university resources; overview of university majors and minors as well as policies and procedures. Exploratory Studies students only. Student cannot get credit for both USC 101 and USC 103.

GEP U.S. Diversity
Typically offered in Fall only

USC 102 Introduction to University Education II (1 credit hours)
Continuation of USC 101. Developmental and academic topics to assist students as they make well-informed decisions about majors and careers. Topics include: career readiness, preparation, and exploration; community and diversity; major and career decision making; assessment of interests, skills, and values; university resources; exploration of university majors and minors. Exploratory Studies students only. Credit cannot be received for both USC 102 and USC 104.

Prerequisite: USC 101
Typically offered in Spring only

USC 103 Introduction to University Education for Varsity Student Athletes I (1 credit hours)
Introduction to University Education for Varsity Student Athletes I provides success strategies for first year student athletes at North Carolina State University. The course is designed to assist student-athletes with the skills and knowledge needed to meet the academic and personal challenges of university life and the increased responsibilities of adulthood, with special attention to the unique challenges and opportunities of student-athletes. Topics include: goal setting, time management, study skills, critical thinking, interaction with the faculty, NCAA and NCSU continuing eligibility, academic integrity, nutrition, and diversity.

Typically offered in Fall and Spring

USC 104 Introduction to University Education for Varsity Student-Athletes II (1 credit hours)
Introduction to University Education for Varsity Student-Athletes II will provide student-athletes with the skills necessary to promote informed decision making in choosing an appropriate major and exploring possible careers. Additional areas of career development, academic success, and personal development will also be addressed as they would relate to the day-to-day responsibilities and challenges that student-athletes face, as well as a review of NCAA and NCSU continuing eligibility.

Prerequisite: USC 103
Typically offered in Spring only

USC 107 College Success for the Pre-College Student (1 credit hours)
USC 107 is designed to assist first-generation pre-college students in making an effective transition to post-secondary education. The course is designed to provide pre-college students with the skills and knowledge needed to address the academic and personal challenges that may impact their progress to degree. Classroom discussions, small group work, guided tours, near-peer mentoring, and access to resources are all vital components of this course. Topics will include campus resources, policies, procedures; study skills; and life management concerns such as health, self-esteem, motivation, goal setting, diversity, and communication. Upon completion, students should be able to function effectively within the college environment to meet their educational goals.

Typically offered in Summer only

USC 110 Freshman Advancement Seminar (1 credit hours)
USC 110 provides an opportunity for a diverse student population to explore the question of race and cultural differences in a global society. This course requires that participants actively explore their biases and cultural prejudices for greater enlightenment. This course challenges sources of conventional information such as media outlets, empirical data and prevailing folklore. The course represents an opportunity to have a positive impact on the matriculation and graduation rate of diverse student populations through positive reinforcement, affirmation of cultural heritage and background. Freshman First Year Entering Students Only.

GEP U.S. Diversity
Typically offered in Fall only

USC 111 Strategies for College Success (1 credit hours)
This course is intended for students who need to improve their academic standing, with enrollment priority given to students readmitted on academic probation. Students will acquire policy and resource knowledge, practical skills, and strategies to improve their academic standing at NC State University. Students will address the academic and personal challenges that may have impacted progress towards their chosen degree. Department Consent Required

Typically offered in Fall, Spring, and Summer

USC 116 Introduction to Sustainability for EcoVillage (1 credit hours)
This course serves as an orientation for students participating in the EcoVillage Living-Learning Village and provides an introduction to the topic of "sustainability." Students have the opportunity to network with their fellow Village residents, campus partners, and guest faculty while performing service learning and during class group activities and discussions. Students will assess their personal definitions, connections to, and impacts on sustainability. This course is required for all first-year EcoVillage residents. This course meets the requirements for the Interdisciplinary Perspectives GEP Category.

Restricted to students participating in the EcoVillage Living-Learning Village
GEP Interdisciplinary Perspectives
Typically offered in Fall and Spring

USC 120 SERV- Seminar Education for Military Veterans/Service Members (1 credit hours)
The USC 120 class will help military veteran/service members transition into the academic environment and campus community. Topics include academic success skills, academic culture, campus resources and student services. Military Veterans (Active and Veteran)

Typically offered in Fall and Spring

USC 201 Exploring Majors, Careers, and Identities (2 credit hours)
Selecting a major and career path are critical components of academic success at NC State and beyond. Exploratory Studies focuses on supporting students as they acclimate to campus, learn about themselves, develop skills, and utilize tools to make informed decisions about their major and career paths. This class will focus on the academic transition to college, exploration of majors and careers, understanding the role of diversity in the community, and assist students as they make well-informed decisions about majors. Additional topics include: community and diversity; assessment of interests, skills, and values; available university resources; overview of university majors and minors as well as policies and procedures. Course limited to Exploratory Studies Spring Connection Students.

Students in Exploratory Studies Only
Typically offered in Spring only

USC 202 Career Exploration and Development (2 credit hours)
This course is intended for students who are considering changing their college major and/or are interested in exploring academic major opportunities. Career exploration and development provides students across campus a focused classroom setting to receive career exploration and academic major decision-making assistance. Students will learn about their personal strengths, values, skills, and personality and understand how these self-assessments will affect their major/career decisions. Students will explore the concept of career resiliency while developing professional skills that will be transferable into any college/major.

Typically offered in Fall and Spring

USC 203 Professional Development For Career Ambassadors (2 credit hours)
The course is for Career Ambassadors only. This course will offer learning opportunities that will provide class members with the knowledge, skills and attitude necessary to become effective Career Ambassadors. The top seven career readiness competencies will be explained. Guest speakers, class discussions, group activities, reflections and out of class team building experiences will be utilized to facilitate learning. Restricted to students who are chosen to be Career Ambassadors after the interview process. (Department Approval Required).

Typically offered in Fall and Spring

USC 210 Introduction to College Tutoring (1 credit hours)
All enrolled students must be employed as ASC tutors. The purpose of the course is threefold: to introduce tutors to effective tutoring techniques based on educational research, to help tutors implement a variety of tutoring methods depending on the students' specific needs, and to guide tutors in self-evaluating their individual tutoring progress and goals. Departmental Approval Required. GPA 3.25 or higher.

Prerequisite: Cumulative GPA greater than or equal to 3.25
Typically offered in Fall, Spring, and Summer

USC 220 Leadership and the Resident Mentor (3 credit hours)
Course will provide the student basic concepts of involvement theory, group development theory and community development relevant to residence hall living as a paraprofessional leader on the campus; the basic principles related to leadership with emphasis on how one develops and leads with their values, beliefs and attitudes and develop skills involving active listening, communication, conflict management and mediation techniques; basic program development and presentation skills; teaching pedagogy; and diversity issues. Some out of classroom activities are required. Departmental approval required.

Typically offered in Fall only

USC 223 NSP Student Leader Development (2 credit hours)
For New Student Programs Student Leaders only. Relevant research, student development theory, and shared professional experiences are presented. This course will offer learning opportunities that will provide class members with knowledge, attitude, and skills necessary to become effective NSP Student Leaders. Class discussion, small groups activities, simulations, and writing employed. Individual projects and out-of-class team building experiences are required, including Saturday activities. Departmental Approval Required.

Typically offered in Spring only

USC 225 Leadership Development for University Ambassadors (2 credit hours)
Course provides University Ambassadors with the knowledge, mindset, and skills necessary to effectively represent the University in a variety of settings to a variety of constituents. Course prepares students to emerge as leaders within the Ambassador program and throughout their University experience. Restricted to University Ambassadors only.

Requisite: University Ambassadors Only
Typically offered in Fall and Spring

USC 240 Leadership and Coalition Building in Diverse Communities (3 credit hours)
Exploration of US diversity and effective leadership practices using the National Coalition Building Institute (NCBI) model. NCBI is an international non-profit leadership development network dedicated to elimination of racism and other forms of oppression. Students will be introduced to the NCBI model which involves significant self-discovery, active listening and dialogue, and participate in activities that establish leadership strategies applied in various contexts. Each practical learning tool is grounded in principles that will be explored through group discussions and reflective journaling. Specific skill training will focus on conflict resolution, creating inclusive environments, strategies for effective listening/communication, personal growth and development. This course is intended for undergraduates, sophomores and above.

Prerequisite: Class Level = Sophomore, Junior, or Senior
GEP U.S. Diversity
Typically offered in Fall and Spring

USC 260 Research as a Profession (2 credit hours)
Broadly defined, research is an interconnected and global process that adds new knowledge, creativity, and innovation to any discipline, from the sciences to the arts to the humanities and in between. During the first half of this course, students will build a foundation of knowledge in the research enterprise including inquiry, research methods, and research governance in a cross-cultural, multi-disciplinary context. Through the use of site-specific case studies, students will analyze past discoveries and innovations that have shaped our current world. This analysis will then become the basis for a research project during the study abroad component of the course. Upon their return, students will learn to synthesize their findings, draw conclusions, and present their research in a cross-disciplinary manner, developing strong oral and written communication skills. To enroll, students must be accepted to the associated study abroad program. All majors are encouraged.

GEP Interdisciplinary Perspectives
Typically offered in Spring and Summer

USC 291 Service Learning Program Leader Development I (1 credit hours)
The purpose of the course is to prepare students for their role as Alternative Service Break Team Leaders. The course will incorporate the larger issues of citizenship, social justice, and positive change and will include the logistics, risk-management, and leadership skills needed when leading a service trip. This course will require students to think critically about their role as a leader. Students will participate in a weekend overnight retreat. Transportation for the retreat will be provided by University Van rental. Expenses for the weekend retreat are covered in the ASB administrative charge paid by participants.

Typically offered in Fall only

USC 292 Service Learning Program Leader Development II (2 credit hours)
The purpose of the course is to prepare students for their role as Alternative Service Break Team Leaders. Part II of the Service Learning Program Leader Development will build upon what students learned in Part I and they will be able to put into practice what has been learned with their own teams. Students will travel with their respective teams during spring break to complete the week long service-learning project. Students will be responsible for fundraising for approximately half the cost of their trip. Trip costs vary and depends on location selected.

Prerequisite: AEE 291
Typically offered in Spring only

USC 293 Independent Study (1-3 credit hours)
A course in which students participate in individualized, independent, directed, or guided studies under the supervision of the instructor of the field or discipline. Topic, mode of study, evaluation criteria, and credit hours to be determined in consultation with the supervising faculty and documented. Course may be taken a maximum of three times provided the topic is sufficiently different. Individualized/Independent Study and Research courses require a "Course Agreement for Students Enrolled in Non-Standard Courses" be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall, Spring, and Summer

USC 298 Special Topics in University Studies (1-6 credit hours)
Special Topics in University Studies at the Undergraduate level for offering of courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

USC 301 Transfer Student Success (1 credit hours)
USC 301 is designed to assist new transfer students in making an effective transition to the rigors of a large research university. The course is designed to provide students with the skills and knowledge needed to address the academic and personal challenges as well as other transitional issues that may impact their progress toward their degree. Classroom discussions, small group work, guided tours, faculty mentors and introduction to resources, services and opportunities are all vital components of this course. Topics include: academic adjustment, social adjustment, campus resources, major and career exploration, policies and procedures, financial aid, and technology. COURSE IS RESTRICTED TO FIRST OR SECOND SEMESTER TRANSFER STUDENTS. Students will not received credit for both USC 301 and ALS 303 or T 101.

Typically offered in Fall and Spring

USC 401 Transitions for the College Graduate (3 credit hours)
Focus on the unique transitions the student will face upon leaving college. Through a variety of formats, students will have the opportunity to explore several aspects of their post-baccalaureate lives and ways in coping with emerging careers, money management, extracurricular retirement, transitional issues, civic engagement, and continuing education opportunities. Explorations of these areas include specific emphasis on developing and refining interviewing skills, professional and personal networks, financial endeavors, and job application and selection.

Typically offered in Fall and Spring

Veterinary Medicine-Companion Animal & Sp Species (VMC)

VMC 900 Advanced Equine Medicine (1 credit hours)
This course will build upon topics covered in VMC 952 Equine Medicine and Surgery. Lectures will cover equine medical problems in more depth than in the previous course. Additional topics will also be included. This course is designed for students who plan to practice equine medicine after graduation.

Typically offered in Spring only

VMC 901 Advanced Small Animal Medicine (2 credit hours)
This course provides more advanced instruction on medical and surgical diseases of dogs and cats. Pathophysiology, diagnostic evaluation and medical and surgical management of diseases in nephrology, urology, oncology, respiratory medicine, infectious diseases, gastroenterology, cardiology and endocrinology are contained within this course. This advanced content of this course is designed to run alongside the content in VMC 951.

Typically offered in Fall only

VMC 902 Small Animal Rounds (1 credit hours)
Course incorporates weekly rounds on actual cases in the NCSU-CVM. Students will practice clinical reasoning, test interpretation and oral and written case presentations in a low stakes, safe environment. Real cases will provide a comprehensive application of the pre-clinical courses. Weekly repetition of these skills will prepare students for clinical practice.

Typically offered in Spring only

VMC 903 Advanced Equine Surgery and Lameness (1 credit hours)
Course will augment areas noted by the syllabus of core equine surgery and lameness presented in VMC952. In the course surgical alternatives, techniques and outcomes will be presented at a level that a student graduating with an equine or mixed focus could describe and discuss treatments with clients or comfortably function in an internship environment

Typically offered in Fall only

VMC 904 Advanced Equine Theriogenology (1 credit hours)
This course provides more advanced instruction in equine Theriogenology (mare and stallion). Diagnostic evaluation and techniques, with expansion on basic core concepts introduced in previous course content are contained within this course.

Typically offered in Fall only

VMC 905 Advanced Topics in Small Animal Dermatology (1 credit hours)
This course will provide broad understanding of small animal dermatology by building upon the basic foundation principles covered in VMC 951. Students will learn to recognize, diagnose and treat both common and uncommon skin diseases of small animals.

Typically offered in Spring only

VMC 906 Equine Field Skills Elective (2 credit hours)
This course will provide practical instruction in commonly used skills and techniques necessary for equine primary care practice. It is an intensive, team taught series of individual laboratories that provide students with experience in the varied skill set required of an equine general practitioner. This course is designed for students that are in the third year of the DVM curriculum, have good horse handling skills and a desire to practice equine veterinary medicine upon graduation. Registration for this course is by instructor permission only.

Typically offered in Spring only

VMC 907 Small Animal Comfort Crew (1 credit hours)
This course is an introduction to patient care in the Terry Center. Students will receive instruction on low stress dog and cat handling, hospital protocols in the general wards, intermediate care unit (IMC) and intensive care unit (ICU), and topics such as the transplant program, management of postoperative patients, and student elected topics based on patients they have cared for. Students will play an active role in improving in hospital patient care through hands on comfort sessions with in patients.

R: DVM Students Only
Typically offered in Fall and Spring

VMC 908 Advanced Small Animal Neurology, Ophthalmology, and Orthopedics (2 credit hours)
This course will provide a more advanced approach to the medical and surgical management of selected metabolic, neoplastic, nutritional, immune mediated, developmental and degenerative diseases and traumatic injury of the ophthalmologic, neurologic, and musculoskeletal systems of small animals. It is a companion course to material given in VMC961. Concurrent enrollment in third year of DVM curriculum.

Typically offered in Spring only

VMC 909 Feline Medicine (1 credit hours)
This course will equip students for success in feline practice or in small animal or mixed practice with a feline component. The course will address the basic behavioral and nutritional needs of cats, and students will learn how the unique physiology of this species affects feline health and feline disease management.

Typically offered in Spring only

VMC 910 Careers in Veterinary Medicine (1 credit hours)
Specialists and invited speakers from multiple areas of veterinary medicine will present information about career opportunities.

Typically offered in Fall only

VMC 914 Group Communication in Veterinary Medicine (1 credit hours)
This course explores how to effectively communicate in small groups in a professional veterinary context. Students will develop verbal and nonverbal communication skills, an understanding of task/process balance, meeting management and facilitation techniques, and communication styles and strategies for dealing with challenging group situations and conflict management. Examples and cases from veterinary medicine will guide application of group communication in context. Course limited to students enrolled in the DVM curriculum.

Typically offered in Fall only

VMC 919 Clinical Behavior and Welfare for Dogs and Cats Elective (1 credit hours)
This is a one-credit course in clinical veterinary behavioral medicine and welfare, with an emphasis on diagnosis and treatment of behavior problems of dogs and cats. The course will build upon the foundation of normal versus abnormal behavior and learning theory of VMC 927. This course will focus on the recognition of common problem behaviors in dogs and cats and how to approach a behavior problem with a systematic Problem Oriented Approach (POVMR). The presentation, proposed etiology and pathogenesis, differential diagnosis, and plan formulation-including diagnostic, treatment, and education plans, will be discussed for common problems. Behavioral medication and complementary products will be included when discussing treatment plans. Additionally, the impact on animal welfare and the human-animal bond will be discussed. Problems to be reviewed include noise aversion, separation anxiety, compulsive disorders, housesoiling, fear and anxiety related problems, problems presenting with aggression, cognitive dysfunction, and some nuisance behaviors.

Prerequisite: VMC 927 or equivalent
Typically offered in Fall only

VMC 921 Special Topics in Zoological Medicine (1-3 credit hours)
This elective course allows students to participate in customized laboratory and field experiences in zoological medicine (avian, aquatic, reptile, amphibian, invertebrate, and mammalian species). This course is designed to be adapted to the needs of students in the DVM program who desire practical experiences in the discipline. Specific details of individual projects are developed by the course coordinator and participating faculty. this elective course can provide partial fulfillment for elective credit for Zoo Focus Area

Prerequisite: 1st, 2nd, or 3rd year DVM student
Typically offered in Fall and Spring

VMC 922 Veterinary Acupuncture in China (2 credit hours)
This elective course is a two week international experience in China that will introduce DVM students to Traditional Chinese Veterinary Medicine (TCVM), including acupuncture, moxibustion, and related therapies. The course will include an overview of TCVM history, terminology, theory, and practical applications using equine (horse or donkey) and canine species. In addition, the course will include elective opportunities to meet and interact with Chinese veterinary students, and opportunities to explore the many cultural options available in China.

Prerequisite: VMB 911 and VMB 921; Corequisite: Current enrollment in the DVM program
Typically offered in Spring only

VMC 923 Research in Zoological Health (1-4 credit hours)
This course provides an opportunity to pursue mentored research projects relevant to zoological health while in the DVM curriculum. Projects may be but are not limited to those related to the zoological focus thesis option.

Restriction: DVM student status. By Instructor Permission only.
Typically offered in Fall and Spring

VMC 924 Equatorial Zoology and Medicine In GalÃ¡pagos (1 credit hours)
This unique opportunity will allow DVM students to experience a unique, equatorial archipelago and much of its natural history offerings. The GalÃ¡pagos Science Center (GSC) will serve as the base of operations. Dr. Gregory Lewbart, who has worked at the facility four separate times, will be the local program leader and guide. He will be assisted by local and visiting scientists. Lectures, laboratory sessions, and field trips will cover a wide variety of zoological and medical topics dealing with native invertebrates, fishes, reptiles, birds, and mammals. There will be an emphasis on aquatic species and a paper is required.

Typically offered in Spring only

VMC 927 Introduction to Companion Animal Behavior (2 credit hours)
This course explores the behavior of companion animals from a veterinary perspective. An emphasis is placed on behavior as an indicator of welfare and health, humane handling of animals, prevention of behavior problems, and treatment of common behavior problems. In addition the nature of human-animal bond and ethical issues relating to human-animal interactions will be discussed. Students will learn how to diagnose and treat common behavior problems on the basis of video-rich case presentations, lecture material, and class discussion. This course is restricted to students enrolled in the DVM Curriculum.

Doctor of Veterinary Medicine Majors Only
Typically offered in Spring only

VMC 928 Topics in Wild Reptile Medicine (1 credit hours)
The NCSU-CVM Turtle Rescue Team treats sick and injured wild reptiles (mostly turtles) belonging to over a dozen different species. First, second, and third year veterinary students taking this course will be responsible for case management, coordinating consultations, diagnostic testing within the hospital, and placing recuperating animals with local wildlife rehabilitators. Students are also required to attend periodic rounds and attend eight lectures about amphibians and/or reptiles, separate from the core and Selective curriculum.

Typically offered in Fall and Spring

VMC 930 Rehabilitation and Mobility Clinical Rotation (2 credit hours)
In this course, students will gain a general understanding of veterinary rehabilitation therapy, including principles and protocols of assessment and treatment, tissue healing, the theory and application of treatment modalities and the common conditions treated.

Requisite: Currently enrolled DVM student
Typically offered in Fall and Spring

VMC 932 Principles of Surgery (3 credit hours)
This course covers the science, art and craft of surgery, as a foundation for clinical applications. The principles you learn will give you a foundation for performing surgery on all species, even though the examples in this course are centered on the dog and cat.

Prerequisite: 2nd year DVM student
Typically offered in Fall only

VMC 933 Theriogenology (2 credit hours)
The physiology, endocrinology, and pathology of the reproductive system are presented. Emphasis includes genital anatomy and function, endocrine interrelationships, and methods for examination of mammary gland and reproductive tract function, including diagnosis and treatment of clinical disorders.

Typically offered in Fall only

VMC 937 Introduction to Physical Examination Skills- Small Animal (1 credit hours)
Introduction to physical examination, laboratory sample collection, and medication administration skills in dogs and cats. Students will also be taught how to understand and use the problem oriented approach for patient management. Students must be enrolled in the Doctor of Veterinary Medicine program. Enrollment in year 2 of Doctor of Veterinary Medicine Program.

Typically offered in Spring only

VMC 938 Advanced Small Animal Primary Care (2 credit hours)
Advanced exposure of clinical year veterinary students to a small animal primary care veterinary practice. There will be several areas of focus to increase efficiency and/or enhancement of pre-existing abilities: clinical skills relevant to a primary care veterinary practitioner; strong problem solving abilities; strong communication skills necessary to interact effectively with clients, colleagues and staff; incorporating and conducting behavioral evaluations of pets during wellness examinations. Enrollment in this course is limited to students in the DVM professional program that have passed VMC 939 (Small Animal Primary Care).

Prerequisite: VMC 939
Typically offered in Spring only

VMC 939 Small Animal Primary Care (2 credit hours)
This rotation is designed to immerse fourth year veterinary students in a primary care small animal veterinary practice experience. There will be several areas of focus: teaching clinical skills relevant to a small animal veterinary practitioner, developing strong communication skills necessary to interact effectively with clients, colleagues and staff, incorporating and strengthening behavioral evaluations of pets during wellness examinations and developing strong problem solving abilities. Enrollment in this course is limited to students in the DVM professional program.

Typically offered in Fall, Spring, and Summer

VMC 940 Clinical Theriogenology (2 credit hours)
This course is designed to instruct veterinary students to make clinical diagnoses and problems of the reproduction system of domestic animals. Instruction is provided on medical and surgical correction of clinical reproductive system problems, such as infertility, obstetrical procedures, assisted reproductive techniques, and traumatic injuries. Must be enrolled in fourth year clinical rotations.

Typically offered in Fall and Spring

VMC 941 Special Topics in Theriogenology (2 credit hours)
The primary objective of this course is to provide additional information and training to veterinary students that have taken the VMP 980 (VMC 940 new course #) clinical theriogenology senior clinical rotation. Emphasis will be directed to acquaint students with modern and current practices of clinical Theriogenology. It is expected that the majority of the information and activities offered in this course will involve equine species (80%) and, to a lesser extent, canine (10%) and bovine species (10%). Requires satisfactory completion of 3rd year of professional program and clinical theriogenology senior rotations.

Typically offered in Fall and Spring

VMC 942 Principles of Medicine (2 credit hours)
This cross-species course provides an introduction to the principles of disease and injury state common to all species. Content in this course is intended to prepare the students for third year DVM medicine and surgery courses.

Typically offered in Spring only

VMC 943 Laboratory Animal and Zoological Species Health and Disease I (1 credit hours)
Principles of applied biology, management, physical examination, and medical techniques, health problems and medical treatment of laboratory and companion fishes, amphibians, and reptiles will be presented. Laboratory sessions will include handling of live animals, examination of necropsy specimens, and case discussions. Students must be enrolled in the Doctor of Veterinary Medicine program.

Typically offered in Spring only

VMC 944 Introduction to Clinical and Professional Communication (1 credit hours)
The ability to communicate with clients is important to successful veterinary practice. The focus of this course is to explore how to effectively communicate with clients in a clinical context. Students will develop verbal and nonverbal communication skills, an understanding of relationship-centered care, management of client interactions, getting informed consent, and communicating complex information. Examples and cases from veterinary medicine will guide application of clinical communication in context.

Typically offered in Spring only

VMC 945 Mobile Veterinary Hospital Shelter Surgery and Medicine (2 credit hours)
This course is designed to offer students additional experience in general small animal soft tissue surgery and shelter medicine. Through partnership with Central North Carolina animal sheltering organizations and utilizing the NC State Mobile Veterinary Hospital, students will primarily gain small animal spay/neuter experience and may also perform additional surgical procedures as needed based on animal patient condition and student abilities. Secondarily, students will also provide medical care for sheltered pets including but not limited to primary wellness care, treatment of sick and injured animals and may perform heartworm testing and treatments as needed. This opportunity will consist of an evolving list of external partners that could additionally include community cat organizations and foster care sheltering networks for any given rotation.

Typically offered in Fall and Spring

VMC 946 Extramural Business Management Experience (2 credit hours)
This course is designed to offer students additional business experience in the veterinary industry. Through partnership with external organizations, students will gain business experience and explore topics such as emerging business, legal, and ethical issues, practice management, human resource management, employment contracts and negotiations, buy and selling veterinary practices, and practice financing. This opportunity will consist of an evolving list of external partners and could include organizations offering practice management consulting, human resource consulting, business consulting, insurance and financing.

Prerequisite: 4th year DVM student
Typically offered in Fall only

VMC 947 Practice Management: Evaluating the workflow, services, and financial performance of a hospital (2 credit hours)
The Practice Management rotation is designed for students interested in obtaining a deeper understanding of how to manage a successful veterinary practice. This experience will give students the opportunity to apply business principles learned in the classroom to real world practices. Students will use assessment tools provided to analyze veterinary practices and provide constructive feedback to practice owners. Students will be expected to interview practice owners and staff, observe practice flow and patient care, and perform an in depth financial analysis. Students will then prepare a written summary and present their findings and appropriate recommendations to the practice owner(s).

Prerequisite: 4th year DVM student
Typically offered in Fall and Spring

VMC 948 Clinical Rotation in Veterinary Radiation Oncology (2 credit hours)
This is an elective rotation during the 4th year of CVM professional studies providing an introduction to veterinary radiation oncology. Basic information about radiation therapy equipment, treatment planning and delivery, and outcome of patients treated for various cancers with radiation therapy will be emphasized. Students will be assigned cases being seen by the radiation oncology service as inpatients, outpatients, and new referral appointments.

Prerequisite: VMB 960
Typically offered in Fall and Spring

VMC 949 Equine Primary Care (4 credit hours)
This 4 week course will provide students with an initial one week of intensive clinical experience in equine primary care and three weeks with a NCSU CVM approved equine primary care practice. Students will be seeing a variety of primary care cases from CVM staff and faculty owned horses, state owned horses, and horses from non-profit organizations during the first week at Southern Pines; including vaccinations, dentistry, lameness, imaging, nasogastric intubation, and field surgery. This course is not an externship and students will have outcome assessments from the instructor as well as the veterinarian at the equine primary care practice. During the final three weeks, students will be exposed to a general equine primary care practice. Students will be expected to examine cases, discuss differentials, provide a treatment plan, perform treatments, and provide client communication. Instructor approval for enrollment required.

Prerequisite: 4th year DVM student
Typically offered in Fall and Spring

VMC 950 Sea Turtle Medicine and Rehabilitation (2 credit hours)
This course provides practical experience in husbandry and disease diagnosis and treatment in rehabilitating sea turtles at the Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSRRC) in Topsail Beach, NC. Skills to be acquired in clinical and didactic setting include sea turtle husbandry and rehabilitation techniques, diagnostic sample collection and interpretation, physical examination and safe handling, medication delivery, wound treatment, and necropsy protocols.

Prerequisite: 4th year DVM student
Typically offered in Fall only

VMC 951 Companion Animal Medicine and Surgery I (4 credit hours)
Overview of medical and surgical management of selective metabolic, neoplastic, nutritional, immune-mediated, developmental and degenerative diseases of companion animals.

Typically offered in Fall only

VMC 952 Equine Medicine and Surgery (3 credit hours)
Medical conditions in large domesticated animals are presented in this course. Discussions involve the agents causing diseases and the therapeutic methods used to correct. 3 semester hours.

Typically offered in Fall only

VMC 953 Laboratory Animal and Zoological Species Health and Disease II (3 credit hours)
Principles of applied biology, management, physical examination and medical techniques, health problems and medical treatment of laboratory animals,small companion mammals and zoological species will be presented. Laboratory sessions may include handling of live animals, examination of necropsy specimens, and case discussions. Laboratory Animal and Zoological Species Health and Disease II will focus on avian and mammalian species. Students must be enrolled in the Doctor of Veterinary Medicine program.

Typically offered in Fall only

VMC 954 Companion Animal Medicine for Food Animal Students (2 credit hours)
Small animal medicine clinical rotation emphasizing the disciplined detection, prioritizing and planning for therapy of medical diseases in small companion animals. Development of medical judgment and the use of the problem oriented medical record is stressed. This course is intended for DVM students in the food animal focus area.

Prerequisite: Senior DVM student
Typically offered in Fall and Spring

VMC 955 Extramural Experiences in Lab An Med (2 credit hours)
DVM students will have the opportunity to undertake a two-week rotation in an approved labratory animal facility under the supervision of a labratory animal veterinarian. This opportunity will meet the need to increase "hands-on" experience as partof the focus area requirements or recommendations.

Corequisite: Current enrollment in DVM program.
Typically offered in Fall and Spring

VMC 956 Advanced Clinical and Professional Communication (1 credit hours)
The ability to communicate with clients is important to successful veterinary practice. This course explores how to effectively communicate with clients in a clinical context during problem appointments. Students will develop verbal and nonverbal communication skills and an understanding of how to manage difficult client interactions including 1) communicating about money, 2) communicating during adverse events, and 3) communicating during euthanasia. Examples and cases from veterinary medicine and simulated client interactions will guide application of clinical communication in context.

Prerequisite: 3rd year DVM student
Typically offered in Fall only

VMC 957 Introduction to Clinical Practice (1 credit hours)
This course has 4 components: a surgery laboratory, a clinical skills laboratory, a communication and wellness case-based facilitated session and community-based experiences. Taken together, these experiences are designed to give students practice and confidence in skills related to small animal general practice.

Typically offered in Fall only

VMC 958 Advanced Prosimian Medicine (2 credit hours)
This course is designed to provide senior veterinary students with clinical experience in prosimian medicine. Students will gain practical experience in the diagnosis, treatment, and prevention of disease in captive prosimians maintained in research facilities. Students participate in formal rounds, autodidactic exercises, and case management at the Duke Lemur Center. Limited to 4th Year DVM curriculum students.

Prerequisite: VMC 991, restricted to 4th year DVM students
Typically offered in Fall and Spring

VMC 959 Advanced Primate Medicine (2-4 credit hours)
The delivery of health care and management to captive and free-ranging primates is a component of zoological, wildlife, and laboratory animal medicine. There is a distinct body of information and techniques for the practice and an increasing demand and opportunity for veterinary graduates with this knowledge. Practical application of techniques and methods for diagnosing disease, delivering health care, and devising preventative medical programs in a research primate facility environment will enable students to evaluate their potential role in the field and equip them to evaluate and responsibly deal with medical issues involving primates.

Typically offered in Fall only

VMC 960 Small Animal Emergency Service (2 credit hours)
Assessment, triage, and management of canine and feline patients admitted to the small animal emergency service after hours.

Prerequisite: fourth year clinics student, DVM student
Typically offered in Fall and Spring

VMC 961 Companion Animal Medicine and Surgery II (3 credit hours)
This course is an overview of medical and surgical management of selected metabolic, neoplastic, nutritional, immune-mediated, developmental, and degenerative diseases of companion animals.

Typically offered in Spring only

VMC 963 Extramural Experience in Zoological Medicine (2 credit hours)
This elective senior year rotation allows students to obtain clinical, laboratory, field, and research experiences in zoological medicine that augment the basic rotations in the zoological medicine focus area. Students can customize their training through participation in a variety of opportunities including epidemiology projects, other basic or clinical research projects, and externships involving captive and free-ranging wildlife & zoo species. does not fulfill senior year requirement for elective credit in Zoo Focus Area

Requisite: Currently enrolled DVM student
Typically offered in Fall and Spring

VMC 965 Advanced Principles of Surgery (1 credit hours)
This laboratory includes induction and maintenance of anesthesia in representative companion animal, food animal, and equine species; the practice of surgery on anesthetized animals and cadaver specimens; and experience with diagnostic and therapeutic techniques. Students examine, assess, and provide preoperative, intraoperative, and postoperative management of their patients.

Prerequisite: DVM student, Completion of fall semester, VM3 students
Typically offered in Spring only

VMC 966 Equine Emergency and Critical Care (2 credit hours)
An intensive course in the assessment and management of equine emergencies. This would include evaluation of patients, surgical and medical treatment of in house and emergency critical care patients, and post-operative assessment and management. Students will gain valuable practical experience of critically ill patients and rounds will be held daily to ensure a high level of learning.

Prerequisite: 4th year DVM student, Third year veterinary curriculum
Typically offered in Fall and Spring

VMC 967 Clinical Veterinary Dentistry (2 credit hours)
Will participate in examination, admission, diagnosis treatment, discharge, and follow-up of patients in dentistry service. Take a clinical history, perform a physical examination, develop appropriate diagnostic plan, discuss the plan with the service's clinicians, and participate in formulation of treatment protocol. Service treats patients Monday-Thursday, Friday reserved for overflow, emergencies, research and teaching. Students given prepared lectures on dental procedures and diseases, and will be allowed to perform supervised procedures on cadavers. (No animals euthanized for this purpose.)

Typically offered in Fall and Spring

VMC 968 Equine Orthopedic Surgery and Lameness (2 credit hours)
Application of problem solving skills and the art, science, and practice of equine orthopedic surgery and lameness in the veterinary teaching hospital setting.

Prerequisite: DVM student, Completion of 3rd year veterinary curriculum
Typically offered in Fall and Spring

VMC 971 Comp Animal Med II (4 credit hours)
1. Obtain a thorough history and perform a complete physical examination. 2. Identifying, defining, and prioritizing problems. 3. Developing and initiating rational diagnostic and therapeutic plans. 4. Performing certain diagnostic and therapeuticprocedures. 5. Interpreting results of diagnostic tests, and determining their importance to the patient. 6. Verbal and written communication with clinicians, clients, veterinary techniques, fellow student veterinarians, and referring veterinarians. 7. Determining the point at which it is time to refer a case to a colleague for Â¿another lookÂ¿, or to a referral center for specialized diagnostic testing or treatment. 8. Understanding how cases management in private practice compares with referral practice. 9. Approaching issues regarding euthanasia; your decision-making, assisting the owner.

Typically offered in Fall and Spring

VMC 972 Clinical Small Animal Veterinary Cardiology (2 credit hours)
Two-week clinical rotation to provide senior veterinary student training in diagnostic and therapeutic aspects of veterinary small animal cardiology. Clinical experience with patients and clents of Veterinary Teaching Hospital and topic and case review rounds.

Prerequisite: 4th yr. standing in the veterinary curriculum at the CVM, Successful completion of 3rd yr. of Veterinary Curriculum
Typically offered in Fall and Spring

VMC 973 Small Animal Surgery (2 credit hours)
Clinical rotation on the small animal surgery services. Students will be assigned to one of two services, general surgery or orthopedic surgery. Students see cases and assist with care of small animal surgical patients. Students will be on-call to assist with emergency surgery cases.

Prerequisite: Completion of third year veterinary curriculum
Typically offered in Fall, Spring, and Summer

VMC 974 Equine Dentistry and Podiatry (2 credit hours)
This course will provide practical instruction in commonly used skills and techniques necessary for equine dentistry and equine podiatry. It is an intensive, team taught series of didactic lectures, individual laboratories, and clinical case experiences with practitioners that provide students with a high level of experience in equine dentistry and equine podiatry. This course is designed for students in the fourth year of the DVM curriculum, with good horse handling skills and a desire to practice equine veterinary medicine upon graduation. This course is strongly recommended for students with an equine focus or mixed animal focus with an equine concentration. Students must have basic equine handling experience and/or have taken the Equine Behavior Selective. Equine, mixed animal, food animal, and exotics focus students will be given preference.

Typically offered in Fall and Spring

VMC 975 Equine General Surgery (2 credit hours)
Application of problem solving skills and the art, science, and practice of equine general surgery in the veterinary teaching hospital setting.

Prerequisite: DVM student, Completion of 3rd year veterinary curriculum
Typically offered in Fall and Spring

VMC 976 Veterinary Critical Care (2 credit hours)
Assessment and management of companion animal emergency and critical care patients, including several 'hands on' laboratories using cadavers to learn and practice emergency and critical care techniques. Principles of emergency and critical patient evaluation, stabilization, and organ system support are the focus of the course. Out-rotations at area emergency clinics are required. Open only to 4th year students in the small animal focus area.

Prerequisite: 4th year DVM student
Typically offered in Spring only

VMC 978 Equine Lameness and Imaging (2 credit hours)
Development and use of problem solving skills and techniques for diagnosis, treatment, and management of lameness in horses.

Prerequisite: DVM student, Completion of the third year of the veterinary curriculum
Typically offered in Spring only

VMC 979 Equine Medicine (2 credit hours)
Students are responsible for all aspects of patient care and are expected to be dedicated to their patients. Frequent and careful observation of the patients, attention to detail, diligent record keeping, accuracy in formulating and carrying out a treatment plan, and use of common sense are expected. The earlier you note potential problems, the earlier and easier they can be resolved. Irresponsibility, carelessness, lack of accuracy, untruthfulness, or a poor attitude will not be tolerated.

Typically offered in Fall and Spring

VMC 980 Vet Clini Oncology (2 credit hours)
This is a two-week, two credit elective rotation during the 4th year of CVM professional studies providing experience in the diagnosis and treatment of cancer in animals. Emphasis is on development of comprehensive cancer management strategies including ethical considerations, diagnostic techniques, treatment options, and client communication skills. Students will be assigned cases being seen by the oncology service as inpatients, outpatients, and new referral appointments.

Typically offered in Fall and Spring

VMC 981 Lab Animal Medicin (2 credit hours)
The block will provide practical experience in the diagnosis, treatment and prevention of diseases of laboratory animals. It will include special study of diseases of laboratory animals and the management of laboratory animal facilities. Opportunity to perform surgical procedures on common laboratory animals will be provided in a series of surgical labs. There will be field trips to other laboratory animal resource facilities within the Research Triangle Park and surrounding areas. The student will present a seminar on a selected topic for critical appraisal by students and faculty.

Typically offered in Fall and Spring

VMC 982 Ophthalmology (2 credit hours)
The purpose of the ophthalmology course is to acquaint the student with examinations, diagnostics and therapeutic practices, and principles of clinical veterinary medicine. There will be direct supervision by faculty and house officers. Attendanceis required at weekly clinical rounds, general medicine rounds, and the patient rounds and mini-seminars conducted within the service. Irregular and/or long hours may be required. Students will be expected to be neatly dressed, well groomed, and conduct themselves in a professional manner at all times.

VMC 983 Dermatology (2 credit hours)
Dermatological disease will represent a significant proportion of your case load, particularly in companion animal practice. Most of the patients that you will see have chronic relapsing disease that can be frustrating, and often costly for the owner. Therefore, whilst an accurate diagnosis represents the first step in dealing with a case, the challenge in this field of medicine is to successfully manage cases in the long term. This requires good and open communication with the client as well as regular patient evaluation. Most of the diagnostic techniques employed in dermatology are very simple and do not require expensive equipment or excessive amounts of time. The key to successful dermatological practice is to use these tools appropriately to recognize conditions such as parasitic infestations and bacterial or yeast infections for which there is a specific course of treatment. It specializes in the diagnosis and management of chronic ear disease and immunological dermatoses such as autoimmune skin diseases, food reactions and atopic dermatitis. The good practitioner however, recognizes that cutaneous manifestations may be a reflection of internal disease and a thorough systemic evaluation is also required. When studying the skin there is one big advantage, it is on the outside.

Typically offered in Fall and Spring

VMC 984 Intro Clin Neuro (2 credit hours)
This service provides diagnosis and management of nervous system disorders in animals, including nuclear imaging, myelography, CT scans, electromyography, neurosurgery, and postoperative patient rehabilitation including hydrotherapy and treadmill training. Attendance is required at weekly clinical rounds, general medicine rounds, and the patient rounds and mini-seminars conducted within the service. Irregular and/or long hours may be required. Students will be expected to be neatly dressed, well groomed, and conduct themselves in a professional manner at all times.

Typically offered in Fall and Spring

VMC 986 Adv Com An Int Med (2 credit hours)
This course provides a higher level experience to diagnosis and management of companion animals with complex medical problems. Students may choose to concentrate on particular aspects of internal medicine. Students are not required to participate in emergency/intensive care unit duty.

Typically offered in Fall and Spring

VMC 987 Aquatic Medicine (2 credit hours)
This course is designed as an elective clinical block rotation in field services, in the final year of the professional DVM curriculum. Students electing the course would have successfully completed the two theoretical/laboratory courses in specialspecies medicine providing the foundation for participation in this course. It is the only clinical course offering hands on experience with medical care delivery to aquatic species.

Typically offered in Fall only

VMC 988 Exotic Animal Medicine (2 credit hours)
This clinical rotation provides practical experience in the diagnosis, treatment and prevention of disease in privately owned small mammals, birds, reptiles, fish, and amphibians. In addition to assisting with the management of clinical cases, students will participate in daily teaching rounds, laboratory activities to increase their technical proficiency, and field visits to various exotic animal collections in NC. Presentation of a short seminar on a clinically relevant topic is required. Irregular and/or long hours, including on-call duty for after-hours emergencies, may be required.

Typically offered in Fall and Spring

VMC 989 Zoological Medicine (4 credit hours)
This course is designed to introduce the senior veterinary students to clinical zoological medicine. Students will gain practical experience in the diagnosis, treatment, and prevention of disease in captive zoological specimens maintained in zoos.Students participate in formal rounds, autodidactic exercises, and case management at the N.C. Zoological Park.

Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives; and Course Coordinator's Permission
Typically offered in Fall and Spring

VMC 991 SP Top in DOCS (1 credit hours)
One week special topic course in the Department of Clinical Sciences

Corequisite: Current enrollment in DVM program

VMC 992 SP Top in DOCS (1-4 credit hours)
Two week special topic course in the Department of Clinicial Sciences.

VMC 993 Equine Special Topics (2 credit hours)
This course is offered to students that have already signed up to take any two of the following courses: Preventative Health Care, Equine Medicine, Equine Surgery, or Equine Theriogenology. The course is designed to give additional experience in equine-oriented clinical services at NCSU. Students will not be able to participate in this block off campus, unless working directly with a NCSU faculty member. A faculty mentor must be identified within one month of signing up for this course and awritten proposal of activities planned submitted to Dr. Gardner.

Typically offered in Fall and Spring

VMC 994 Small Animal 4th Year Extramural Studies (1-6 credit hours)
This course is a recommended rotation designed to expand opportunities for senior veterinary students to participate in small animal private practice a) enhance and learn clinical and technical skills, b) develop effectice client communication skills and time management, and c) observe elements of small business management, including personnel involved and professional financial interactions with private clients. Students will work at a private or corporate veterinary practice under the directsupervision of a licensed veterinarian engaged in small animal practice. Must be senior student in the DVM program.

Typically offered in Fall and Spring

VMC 995 Clinical Conference (1 credit hours)
This weekly seminar course will incorporate a range of topics relevant to success in the clinical year and beyond, including preparation for the NAVLE exam, integration of themes and topics presented elsewhere in the DVM curriculum, job search strategies, employment contracts, financial literacy and loan repayment, critical reflection, and others. The course calendar is based on relevant topics to members of the senior class as they pass through the academic year. Topics will be addressed in an interactive and discussion-based manner and will be selected with input from the student body.

Restriction: Active DVM student in year 4 of the curriculum (successful completion of years 1-3)
Typically offered in Fall, Spring, and Summer

VMC 996 Advanced Exotic Animal Medicine (2 credit hours)
Students will work with client-owned exotic animals in the CVM hospital and our in-house teaching animal colonies to further refine skills in exotic animal handling, diagnostic sample collection for multiple species, and anesthesia and radiology acquisition and interpretation of multiple exotic animal species. Cadavers will be used to teach orthopedic and soft tissue surgical procedures in birds, reptiles, and mammals. Students and faculty will spend 1-5 days in the field, travel restrictions permitting, working with psittacine birds, waterfowl, and potentially raptors at several local parrot rescue organizations and wildlife facilities. Restricted to senior DVM students only that have already completed VMC 988.

P: VMC 988
Typically offered in Fall and Spring

VMC 997 Raptor Medicine and Rehabilitation (2 credit hours)
This elective senior year rotation allows students to obtain clinical experience in raptor medicine and rehabilitation at Carolina Raptor Center in Charlotte, N.C. Students will develop skills with species identification, capture and handling, physical examination, bandaging, diagnostic sample collection and interpretation, emergency stabilization and treatment techniques, necropsy, anesthesia and surgery assistance, and captive management and husbandry issues. A maximum of 2 students will be permitted in each 2-week clinical rotation. For students enrolled in DVM Curriculum. Will partially fulfill senior year requirement for elective clinical rotation credit in Zoo Focus Area.

Typically offered in Fall and Spring

VMC 998 Basic Wildlife Rehabilitation Medicine (2 credit hours)
Wildlife rehabilitation medicine, the delivery of health care and management to free-ranging native wildlife with the goal of re-release is an important component of clinical veterinary medicine. Students in this basic course will work with instructors to learn to apply practical medical and surgical techniques and methods for diagnosing disease, delivering health care, and implementing appropriate triage for injured and ill North Carolina native wildlife. Restricted to DVM Curriculum 4th year students.

Prerequisite: VMC 964 or successful completion of 3 Zoological Medicine Focus Selectives, VMC 989, and Course Coordinator's Permission
Typically offered in Fall and Spring

VMC 999 Advanced Wildlife Rehabilitation Medicine (2 credit hours)
Wildlife rehabilitation medicine, the delivery of health care and management to free-ranging native wildlife with the goal of re-release is an important component of clinical veterinary medicine. Students in this advanced course will apply practical medical and surgical techniques and methods learned in the basic course for diagnosing disease, delivering health care, and implementing appropriate triage for injured and ill North Carolina native wildlife. They will assist staff and faculty in managing cases native to North Carolina.

Prerequisite: VMC 964 or VMC 998
Typically offered in Fall and Spring

Veterinary Science - VMB (VMB)

VMB 900 Veterinary Pain: Physiology and Clinical Problem Solving (1 credit hours)
Course will review the neuroanatomy and physiology of pain with emphasis on veterinary species. The course will also cover clinical treatment options and ethical discussions.

Typically offered in Fall only

VMB 901 Molecular Medicine (1 credit hours)
This elective is designed for all DVM students to augment their training in clinical and basic sciences. Modern medicine is making increasing use of molecular approaches for advancing diagnostic and prognostic modalities, and for developing more effective therapeutic strategies for cancer, metabolic disorders and infectious diseases. This class will outline the concepts underlying current and emerging technologies in molecular medicine, and investigate their utility in a clinical setting. The goal is to equip students with a basic understanding of the appropriate and effective use of molecular strategies, whether directly for patient care, or within academic, industry or government research.

Typically offered in Spring only

VMB 909 Case Based Radiographic Interpretation (1 credit hours)
Using an entirely case based approach, disorders that are commonly diagnosed radiographically in both small and large animals will be discussed. The emphasis will be on radiographic interpretation. Important concepts in radiographic interpretation and how imaging can affect patient management will be discussed.

Typically offered in Spring only

VMB 911 Veterinary Anatomy I (5 credit hours)
Gross anatomy of the dog and cat. Neuroanatomy of the dog and cat. Dissection of embalmed (dog/cat) cadavers, study of prosections, slides, models, and imaging modalities.

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 912 Introduction to Clinical Problem Solving in Veterinary Practice (2 credit hours)
A combination of lectures and in-class activities will be used to explore the clinical reasoning process and steps used in "working up" a veterinary clinical case. Specific topics include: patient signalment, chief complaint, history, physical exam, problem list, differential diagnosis. Also covered: introductory clinical skills, medical records (SOAP). Course limited to students enrolled in the DVM curriculum.

Typically offered in Fall only

VMB 913 Veterinary Physiology and Microanatomy I (5 credit hours)
First course in a two course series on veterinary physiology and microanatomy. Emphasis will be on structure and function which will provide a foundation upcoming courses (e.g. pharmacology, pathology, medicine).

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 914 Histology and Cytology (2 credit hours)
This course focuses on the study of cells, basic tissues, and selected organs of domestic animals. The primary emphasis is on the molecular and structural basis for cell function, tissue organization, and organ systems.

P: Admission to professional veterinary program
Typically offered in Fall only

VMB 920 Small Group Problem Solving in Veterinary Medicine (1 credit hours)
Students will work in small groups with a faculty facilitator to examine case scenarios, and apply the problem-solving process discussed in VMB 912 to a variety of clinical and research problems. This course will provide a venue for integration of content presented in other courses, as well as application of small-group communication skills. Course limited to students enrolled in the DVM curriculum.

Typically offered in Spring only

VMB 921 Veterinary Comparative Anatomy (4 credit hours)
Gross anatomy of domestic ungulates (horse, ox, goat, pig). Involves dissection of embalmed specimens and study of prosections, models, and radiographs.

Typically offered in Spring only

VMB 923 Veterinary Physiology and Microanatomy II (4 credit hours)
A continuation course in veterinary physiology and microanatomy. Emphasis will be on structure and function which will provide a foundation upcoming courses (e.g. pharmacology, pathology, medicine).

Typically offered in Spring only

VMB 930 Anesthesiology (2 credit hours)
Anesthetic principles, agents, and techniques of multiple species.

Typically offered in Fall only

VMB 931 Veterinary Ethics and Animal Welfare (2 credit hours)
This course will explore the major ethical issues confronting the practices of veterinary medicine, biomedical science, and animal welfare. Students will become familiar with legal and institutional positions, consider and debate opposing arguments on the various topics, and examine relevant case studies. Provides the basic leadership and operational training necessary to become a Credentialed responder for the State of North Carolina. Limited to DVM students or by permission of instructor.

Typically offered in Fall only

VMB 932 Veterinary Medical Decision Making (1 credit hours)
A combination of lectures and Moodle activities will be used to explore the medical decision-making process in veterinary medicine and error prevention strategies. Main course themes are errors in: knowledge acquisition, data gathering, data processing and metacognition. Discussion of generation, refinement and testing of diagnostic hypotheses. Course limited to students enrolled in the DVM curriculum.

Typically offered in Fall only

VMB 933 Veterinary Pharmacology I (3 credit hours)
This course focuses on the action of drugs in animals and basic principles of drug disposition and pharmacokinetics. The course will provide presentations on the principles of pharmacology of medications used in animals. Principles of autonomic pharmacology will form a foundation that is important to other drug groups. Important drug groups discussed during the course will be sympathetic and parasympathetic agonists and antagonists, anesthetic, sedative, and tranquilizer drugs. We will then cover medications used to treat conditions of the brain and behavior, hemostatic, endocrine, and respiratory systems. The material you learn in this semester will be building blocks for additional systems therapeutics in the Spring semester (VMB 943). This course will consist of recorded lecture material, case presentations, in-class activities/discussions, individual and group assignments, and presentations by guest lecturers.

Typically offered in Fall only

VMB 936 Introduction to Radiology (1 credit hours)
This course describes and explains the principles of physics of diagnostic radiology and ultrasound, and the basics of image interpretation. Principles of thoracic radiography and radiographic anatomy will be covered. Radiographic interpretation of the cardiovascular system, lungs and airways and pleural space are discussed and related to physiology of the different organ systems. Principles of abdominal radiography and radiographic anatomy will be covered as well and the concepts of peritoneal detail, abdominal mass effect and intestinal ileus will be introduced.

Typically offered in Fall only

VMB 943 Veterinary Pharmacology II (3 credit hours)
A course in veterinary pharmacology with emphasis on the pharmacology of drugs affecting various body systems including digestive, endocrine, ocular, respiratory, central nervous, cardiovascular, or musculoskeletal. Drugs that produce analgesic and anti-inflammatory properties also are included.

Typically offered in Spring only

VMB 944 Veterinary Toxicology and Poisonous Plants (2 credit hours)
Toxicological basis and pathological features of diseases of animals and birds caused by common toxic chemicals and plants with emphasis on clinical manifestations, diagnosis, prevention, and treatment.

Typically offered in Spring only

VMB 952 Specialized Problem Solving in Veterinary Medicine (1 credit hours)
Specialized Problem-Solving is the fourth in a series of courses focusing on Clinical Reasoning and Problem Solving. In this class, you will build upon the skills developed in earlier courses, and work to diagnose, treat and trouble-shoot more complex cases. These cases may have external constraints that will limit your ability to order diagnostic tests, and/or may require identification and correction of medical errors. You will work in unsupervised teams, and then present the results of your decision-making processes to a facilitator for discussion, review and critique. Course limited to students enrolled in the DVM curriculum.

Typically offered in Fall only

VMB 960 Veterinary Radiology and Radiobiology (2 credit hours)
Fundamentals of radiographic diagnosis. The VMB 960 course is focused on the diagnostic imaging appearance of small and large animal thoracic, abdominal, musculoskeletal and neurologic disease. The main imaging modality that will be covered is diagnostic radiology and some diagnostic ultrasound but Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) will be introduced as well. The principles of image interpretation will be revisited and the imaging appearance of important and common diseases will be presented and discussed. Case examples will be shown and students may be asked to provide case interpretation in class.

Typically offered in Spring only

VMB 961 Success in the Clinics and Beyond (1 credit hours)
This course provides an opportunity for students to integrate and synthesize professional skills in preparation for clinical rotations and veterinary practice. An introduction to the current VH electronic medical record system will be provided. Students will apply their knowledge of clinical communication, teamwork, clinical reasoning, and ethics to a variety of case scenarios.

Typically offered in Spring only

VMB 962 Clinician Scientist Research Experience (1-10 credit hours)
This course is designed to give students an opportunity to take part in resaerch int he laboratory of their chosen mentor(s), resulting in a greater understanding of the research process. Students will be specifically required to complete at least three 2-week blocks, and to have at least two of these blocks scheduled consecutively (i.e., a 1-month time period in the laboratory). This course is restricted to students enrolled in the Clinician Scientist Focus Area of the DVM curriculum and requires approval by the student's CSFA mentor.

Prerequisite: All freshman-junior DVM courses allowing the student to enroll in senior DVM courses.
Typically offered in Fall and Spring

VMB 965 Veterinary Nutritional Health (2 credit hours)
The role of nutrition in veterinary medicine. Development, diagnosis and prevention of nutritional problems in a variety of species will be discussed, frequently employing a comparative approach.

Typically offered in Spring only

VMB 976 Radiology Rotation (2 credit hours)
This rotation will provide practical training in the production of quality radiographic examinations and will help develop interpretation skills in diagnostic radiology. Students are expected to be familiar with material covered in the junior radiology course (VMB 960) as it will be incorporated into this rotation. Review of the auto-tutorial teaching cases, located in the "Star Wars" room. The radiology rotation is oriented toward teaching and service. Learning experiences result from a combination of direct contact with the faculty, residents, technicians, and classmates. You will make diagnostic quality radiographs, participate in morning rounds and review didactic material, VMB 960 teaching files and ask questions.

VMB 977 Clinical Anesthesia Rotation (2 credit hours)
Students engage in the daily clinical service responsibilities of the CVM-VTH Anesthesia Section in the role of anesthetists assigned to the care of client-owned animals. The objective of this clinical course is to enable each student to achieve their maximum potential as neophyte anesthetists having limited experience. Student activities are supervised and conducted by CVM faculty anesthesiologists, and VTH staff anesthesia technicians. Supporting activities related to delivering clinical service include attending clinical rounds and case discussions, and oral presentation of a critical review of a recently published research paper relevant to anesthesia and it's supporting basic sciences.

Typically offered in Fall and Spring

VMB 978 Clinical Behavior & Nutrition (2 credit hours)
This 4th year clinical rotation will provide interested students with the opportunity to gain experience in both behavior and nutrition. During the week spent at the Animal Behavior Service, students will participate in the diagnosis and treatment of behavior problems in companion animals. During the week spent at the Nutrition Service, students will develop and initiate Nutrition Support plans for hospitalized and health companion animals. Relevant nutrition support skills will be practiced. This course is restricted to students in the DVM curriculum.

Prerequisite: VMC 927 or equivalent, DVM Curriculum Student Status
Typically offered in Fall and Spring

VMB 991 SP Top in MBS (1-2 credit hours)
One week special topic course in the Department of Molecular Biomedical Sciences.

VMB 992 SP Top in MBS (2 credit hours)
Two week special topic course in the Department of Molecular Biomedical Sciences.

Veterinary Science - VMP (VMP)

VMP 162/PO 162 Livestock and Poultry Disease Management (3 credit hours)
Basic principles of disease and disease management in livestock and poultry. Disease prevention through sanitation and vaccination. Diseases of horses, pigs, ruminants, poultry, and disease prevention programs for each species

Requisite: Agricultural Institute Only

VMP 401 Poultry Diseases (4 credit hours)
Concepts of factors contributing to or causing disease, disease cycle, host responses, and general approaches to prevention and control including management and biosecurity methods, immunization, and medication. Recognition, diagnosis, prevention, control, and treatment of economically significant infectious and noninfectious diseases affecting poultry.

Typically offered in Spring only

VMP 420 Disease of Farm Animals (3 credit hours)
Pathology of bacterial, viral, parasitic, nutritional, thermal and mechanical disease processes for farm animals. This emphasis practices for prevention and control of each disease.

Prerequisite: Junior standing.
Typically offered in Spring only

VMP 900 Global Health Research Project (5 credit hours)
This international elective (Global Health Research Project) will allow students to develop an understanding of methodological approaches and techniques used in global health research, including qualitative field work, quantitative surveys, experimental designs, intervention trials, and program evaluation. This elective will highlight the importance of understanding and addressing global health through multidisciplinary frameworks and collaborations. This elective is a required component of the Certificate in Global Health. Course Coordinator Permission required.

Typically offered in Summer only

VMP 901 Small Ruminant Medicine (1 credit hours)
This is course will present the key principles involved with management, reproduction and diseases of sheep, goats and camelids. This will include basic information such as recommended nutrition programs to more advanced material such as diagnostic, therapeutic and prophylactic measures necessary to correct, reduce or prevent common diseases. Course restricted to 3rd year veterinary students, unless special permission is granted by course coordinator.

Typically offered in Fall only

VMP 904 Swine Industry (1 credit hours)
This course will provide veterinary students with expertise to approach a clinical swine problem and also to understand and analyze different parameters from a swine production. Students will evaluate clinical signs, analyze and understand production records, understand regulations and economic analysis. Students will also learn how to set up clinical trials, to interpret serological and virological results, to perform necropsy and to understand swine reproductive management. Cap Max: 6 students

Restriction: Third Year DVM Students
Typically offered in Spring only

VMP 906 Bovine Assisted Reproduction Techniques (1 credit hours)
Students will gain hands-on experience with bovine rectal palpation, rectal ultrasonography, artificial insemination, embryo flushing, and in vitro fertilization. The course will provide didactic instruction on assisted reproduction techniques followed by lab time to practice discussed topics. Students will be required to travel to lab locations. This course won't embrace first-year students.

Typically offered in Fall and Spring

VMP 907 Cancer Pathogenesis and Diagnosis (1 credit hours)
This course will enable the student to describe the steps that lead from a normal cell to a fully malignant neoplasm, understand underlying molecular mechanisms, and correlate these mechanisms to relevant treatment options. Students will be able to classify different tumor types and deduce the impact of the neoplasm on the host and host responses. Students will also learn to assess clinical samples to make a relevant clinical diagnosis of tumor type and predicted behavior.

Prerequisite: 3rd year DVM student
Typically offered in Spring only

VMP 908 Advanced Ruminant Medicine and Surgery (2 credit hours)
This elective course will be a weekly lecture and lab that covers routine ruminant surgical procedures and advanced medicine techniques to supplement VMP 962 Ruminant Medicine and Surgery.

Typically offered in Spring only

VMP 909 Veterinary International Elective Experience (1-2 credit hours)
This course will provide students with practical experience in a foreign country working on a veterinary medicine related project being conducted in that country. Projects may focus on production medicine, occupational, zoological medicine, or basic research.Travel restricted to sites not included on the State Department alert/warning list. See http://travel.state.gov/content/passports/english/alertswarnings.html for details.

Corequisite: Current enrollment in DVM program
Typically offered in Fall and Summer

VMP 910 Infection and Immunity 1 (3 credit hours)
This course is intended to familiarize the student with the pathogenic bacteria and fungi of veterinary importance. The student will learn the properties and cultivation of these microorganisms and receive a general introduction to the diseases they can cause. Primary emphasis will be placed on how the biology of the pathogen influences disease pathogenesis, and microbiological identification of infectious agents. The laboratory exercises will complement the lectures and focus on standard procedures for microbial cultivation and identification.

Prerequisite:Admission to the DVM Curriculum
Typically offered in Fall only

VMP 916 Health Maintenance and Animal Production I (1 credit hours)
This course is part I of a series with VMP 936 and 956 designed to introduce students to procedures for health maintenance and care of horses and food-producing animals. Students learn how to prevent diseases and promote animal health in laboratories.

Typically offered in Fall and Spring

VMP 920 Infection and Immunity 2 (4 credit hours)
This course is intended to continue the topics introduced in Infection and Immunity 1. Specific bacterial, fungal and viral pathogens will be covered including pathogenesis and strategies used to control infection and/or development of disease. The course will also cover more advanced topics in immunology including the types of hypersensitivities, autoimmunity, immunity in the newborn and fetus, immune deficiencies and vaccination.

Prerequisite:Admission to the DVM Curriculum
Typically offered in Spring only

VMP 921 Problem Solving for Cases in Infectious Diseases and Immunity 1 (2 credit hours)
This course is intended to challenge first-year veterinary students to reach a diagnosis of realistic cases involving either infectious diseases or immune pathology. The first part of the course is an introduction to diagnostic laboratory procedures. The second portion of the course requires the students to develop a list of differential causes to assigned clinical cases, choose a presumptive diagnosis based on available data and ordering of diagnostic tests to confirm the presumptive diagnosis. The individual cases are discussed in a small group format with a faculty facilitator.

Prerequisite:Admission to the DVM Curriculum
Typically offered in Spring only

VMP 930 Infection and Immunity 3 (3 credit hours)
Infection and Immunity 3, VMP93X, is designed to serve as a continuation of Infection and Immunity 1 & 2 (first-year curriculum) for the second-year veterinary student. This course is designed to reinforce principles if infectious disease and immunity introduced in the first year of the DVM curriculum and expand upon specific groups of parasites. This course will cover the diagnosis, treatment and control of major endo and ecto parasites of domesticated animals.

Prerequisite:Admission to the DVM Curriculum
Typically offered in Fall only

VMP 931 Veterinary Pathology I (3 credit hours)
Introduction to the basic pathologic changes which occur in animal tissues. Developmental processes and resulting morphology observed at gross, cellular, and subcellular level emphasized.

Typically offered in Fall only

VMP 934 Problem Solving for Cases in Infectious Diseases & Immunity 2 (2 credit hours)
This course is intended to challenge first-year veterinary students to reach a diagnosis of realistic cases involving either infectious diseases or immune pathology. The first part of the course is an introduction to diagnostic laboratory procedures. The second portion of the course requires the students to develop a list of differential causes to assigned clinical cases, choose a presumptive diagnosis based on available data and ordering of diagnostic tests to confirm the presumptive diagnosis. The individual cases are discussed in a small group format with a faculty facilitator.

Prerequisite:Admission to the DVM Curriculum
Typically offered in Fall only

VMP 936 Health Maintenance and Animal Production II (1 credit hours)
This course is part II of a series with VMP 916 and 956 designed to introduce students to procedures for health maintenance and care of horses and food-producing animals. Students learn how to care for animals, prevent diseases, and milk cows in laboratories.

Prerequisite: VMP 916
Typically offered in Fall and Spring

VMP 941 Veterinary Pathology II (4 credit hours)
Systemic Pathology - A study of specific responses of organ systems to pathogenic influences in animals with emphasis on the effects on the body as a whole.

Typically offered in Spring only

VMP 942 Veterinary Clinical Pathology (3 credit hours)
Introduction to the mechanisms which produce abnormal physiologic parameters within the animal during illness, with emphasis on the techniques for determining those abnormalities in the living animal.

Typically offered in Spring only

VMP 945 Epidemiology & Public Health (3 credit hours)
The focus of this course is to construct a foundation for clinical medicine by acquiring a holistic view of disease, exploring optimal preventive medicine strategies while developing a critical thinking skills and quantitative reasoning techniques. The teaching/learning format of the course will include lecture, in-class exercises, discussions and case studies.

Prerequisite: VMP 912, DVM student
Typically offered in Spring only

VMP 956 Health Maintenance and Animal Production III (1 credit hours)
This course is part III of a series designed to instruct students in procedures for maintaining the health and well-being of horses and food-producing animals. Students learn how to prevent diseases and promote animal production, including production of safe meat and milk.

Typically offered in Fall only

VMP 962 Ruminant Medicine (3 credit hours)
The principles of medical disorders of ruminants are presented. This includes the cause of the disorders and the diagnostic, therapeutic and prophylactic measures necessary to correct, reduce or prevent these problems.

Typically offered in Spring only

VMP 964 Swine and Poultry Medicine (2 credit hours)
Lecture series supplemented with projected illustration on the most economically important diseases of poultry and swine. Emphasis is placed on definition of diseases, etiology, characteristics of the disease, and diagnosis. The economics related to occurrence, prevention, treatment, and control are presented.

Typically offered in Spring only

VMP 970 Ruminant Health Management I (2 credit hours)
This is a two-week block considering health management of ruminant species. During the two-week period, students accompany faculty on visits to farms to deliver health management programs, to investigate health problems, or to consider approaches to enhance productivity. A portion of the course also involves experience in providing individual animal health management and addressing medical/surgical disorders. Available to senior veterinary students.

Prerequisite: VMP 956 or VMP 974 or consent of the instructor
Typically offered in Fall and Spring

VMP 971 Food Animal Diagnostics for Disease Diagnosis, Control, and Population Surveilla (2 credit hours)
This course intended to instruct food animal veterinary students in: 1) underlying principles of veterinary diagnostic assays, 2) proper collection of samples, 3) effective testing approaches for diagnosis and management of disease, 4) strategies for efficient monitering of food animal population for infection by specific agent(s), and 5) analysis of data from veterinary diagnostic laboratory tests and optimal use of the results for making production management decisions. Priority given to students in Food Animal Focus area. Students in Mixed Animal Focus Area or special-case Epidemiology Focus Area students can enroll (if space remains) with the approval of Course Coordinator if they meet the criteria states in the above requisites.

Prerequisite: Prior undergraduate coursework, summer work experiences, and/or consistent enrollment and good performance in food animal selectives.
Typically offered in Fall only

VMP 972 Ruminant Health Management II (2 credit hours)
Senior veterinary students will experience advanced training in ruminant clinical medicine.

Prerequisite: VMF 970
Typically offered in Fall and Spring

VMP 973 Special Topics in Epidemiology (2 credit hours)
The main goal of this course is to provide senior veterinary students with the opportunity for pursuing a focused research topic in the area of veterinary epidemiology and population medicine under the direction of consenting faculty. The exact direction and scope of the topic is agreed upon between the instructor, the student and the course coordinator. The course is offered only by the permission of the participating instructor(s) and the course coordinator. The instructor and the student will work out the type of project, what exact objectives are to be met and how the success of obtaining those objectives will be evaluated. The objectives and methods of evaluation of performance will be negotiated between the veterinary student and the instructor and put into writing in the form of a Plan of Action PRIOR to course permission being granted by the course coordinator.

Typically offered in Fall and Spring

VMP 974 Food Supply Veterinary Medicine (2 credit hours)
This 2-week course provides exposure to the clinical principles of food supply veterinary medicine. It is primarily intended for individuals who are not in the NCSU-CVM Food Animal Focus Area. Ruminant, swine and poultry faculty provide an overview of the animal industries and production practices, as well as exposure to basic veterinary knowledge and clinical skills. Prerequisites may include consent of instructor.

Prerequisite: Completion of first 3 years of veterinary curriculum; consent of instructor for any enrollment >8.
Typically offered in Fall only

VMP 975 Advanced Topics in Veterinary Anatomic Pathology (1-6 credit hours)
This is a two-week senior veterinary clinical rotation that provides students with additional, focused experience in veterinary anatomic pathology. Students have the option of rotating through necropsy service and surgical biopsy service for two weeks to gain additional experience in pathology similar to VMP 977, the prerequisite for this course. Students have the option of designing a specialized pathology experience with the guidance of an approved pathology faculty member. Enrollment requires pre-approval by faculty assigned to the course.

Prerequisite: VMP 977
Typically offered in Fall and Spring

VMP 976 Food Animal Pharmacology (2 credit hours)
This course will outline the basic principles of pharmacology and therapy of the major diseases of ruminants, swine and poultry. Students will be expected to develop a thorough understanding of how properly to use drugs in food animal species and should be able to develop a treatment program for most major livestock diseases. The course will be restricted to students in the food animal and mixed animal focus areas.

Prerequisite: VMB 943; VMP 962; VMP 964
Typically offered in Fall only

VMP 977 Autopsy/ Clinical Pharmacology (2 credit hours)
Two clinical disciplines are completed during this clinical block - Autopsy Pathology and Clinical Pharmacology. The autopsy clinical rotation provides exposure to pathology techniques, observation skills and medical reasoning used to obtain and interpret autopsy and laboratory dat in order to develop diagnoses, understand disease processes and address clinical and/or farm problems. The clinical pharmacology portion of the rotation will expose the students to current veterinary clinical pharmacology and therapeutics.

Typically offered in Fall and Spring

VMP 978 Clinical Pathology and Laboratory Medicine (2 credit hours)
This course provides veterinary students with a practical case-based approach to learning all majors aspects of veterinary clinical pathology and laboratory medicine (parasitology, immunology, bacteriology) in a clinical setting. It is restricted to students enrolled in the fourth year of the DVM curriculum.

Typically offered in Fall and Spring

VMP 979 Epidemiology (2 credit hours)
The main goal is to provide senior veterinary students with the opportunity for pursuing a focused research topic in the area of veterinary epidemiology and population medicine under the direction of consenting faculty. The exact direction and scopeof the topic is agreed upon between the instructor, the student and the course coordinator. This course is offered only by the permission of the participating instructor(s) and the course coordinator. The instructor and the student will work out thetype of project, what exact objectives are to be met and how the success of obtaining those objectives will be evaluated. The objectives and methods of evaluation of performance will be negotiated between the veterinary student and the instructor and put into writing in the form of a Plan of Action PRIOR to course permission being granted by the course coordinator. No one textbook is required for this course.

Typically offered in Fall and Spring

VMP 982 Poultry Health Management I (2 credit hours)
Poultry Health Management I is a clinical rotation elective for 4 th year veterinary students with an interest in poultry health management or food animal production. This two-week course is offered 4 times each year. Diseases of turkeys and chickens will be discussed. Basic concepts in poultry disease diagnosis, prevention and treatment will be emphasized. The course will consist of lectures, laboratory and field experiences.

Typically offered in Fall only

VMP 983 Poultry Health Management II (2 credit hours)
Poultry Health Management II is a clinical rotation elective for 4 th year veterinary students with a commitment to pursue a career in poultry health management or food animal production. This two-week course is offered throughout the year and may be repeated with permission of the instructor. The course will consist of laboratory and/or field experiences designed to meet the student's career goals. A list of available externships in poultry health management, which may be applicable for this course can be found on the Association of Avian Pathologists web site: http://www.aaap.info/index.html, under Educational Opportunities, Senior Veterinary Student Externships approved by the Kenneth Eskelund Preceptorship Committee. Funds to help pay for travel expenses may be available through the Kenneth Eskelund Preceptorship, see information at the web site listed above.

Typically offered in Fall and Spring

VMP 984 Swine Health Management I (2 credit hours)
This course will provide senior veterinary students with techniques and expertise to approach a clinical swine problem. Students will evaluate clinical signs, analyze production records, assess facilities and management, institute a diagnostic plan and establish an economically feasible solution to the clinical problem. The outline for this course may vary slightly from year to year but the following topics will be covered: Necropsy procedures/sample techniques; Interpreting serologic/ virologicresults; Farm visits - review building/equipment designs; Practical swine reproductive management; Practical bacteriology; Practical swine nutrition/rations; Swine record systems/Pig Champ.

Typically offered in Fall only

VMP 985 Swine Medicine & Production II (2 credit hours)
This course will provide senior veterinary students with the opportunity to utilize the techniques and expertise gained in VMF 984. Students will evaluate clinical and production problems on a variety of swine farms. Practicum/field work and independent study will be conducted on commercial swine farms, usually with a veterinary practitioner or faculty member.

Typically offered in Fall and Spring

VMP 986 One Health: From Philosophy to Practice (2 credit hours)
Graduate/professional seminar (with team project) addressing intersections of veterinary medicine, human medicine, and environmental health. Co-listed at UNC CH Gillings School of Global Public Health and Duke University School of Medicine. Includes participants from these three institutions, plus related private-sector members, non-governmental organizations, and governmental professionals. Its purpose is to facilitate understanding of one health as a system of systems, and promote cross-campus and cross-discipline interactions. Weekly evening course held at NC Biotechnology Center, RTP. Limit: 15 students per university. Requires current graduate standing at NCSU or professional student standing within the College of Veterinary Medicine.

Typically offered in Fall only

VMP 987 Ruminant Topics (2 credit hours)
This two-week elective allows goal-directed educational enrichment in Ruminant Practice under the direction of consenting faculty. Formats include clinical experiences, clinical and applied investigations, etc. Topics and times are arranged by the student and consenting faculty. Available to 3 rd and 4 the year veterinary students only upon consent of faculty. VMF 970 may be a required prerequisite.

Typically offered in Fall and Spring

VMP 988 Advanced Topics in Clinical Pathology (2 credit hours)
The goal of the Advanced Topics in Clinical Pathology is to gain further experience in clinical pathology beyond the required prerequisite laboratory medicine rotation VMP978. This senior clinical rotation is designed around the interests and career goals of the student. The focused activities in this rotation are intended to enhance the student's abilities and knowledge within the field of Clinical Pathology. Examples of activities include but are not limited to: 1) self-directed practice in the examination and interpretation of cytology and hematology slides using teaching slides sets; 2) practice describing and interpreting hematology and cytology slides from current clinical cases; 3) interpretation and discussion of complex clinical chemistry cases; 4) development of short research projects; 5) training in flow cytometry and interpretation; and 6) development of educational materials on a topic in clinical pathology.

Prerequisite: VMP 978 (Clinical Pathology, Laboratory Medicine and Nutrition) is a prerequisite course although under special circumstances instructor could permit to take prior to VMP 978 based on student background. Instructor permission is required.
Typically offered in Fall and Spring

VMP 989 Animal Welfare Judging and Assessment (1 credit hours)
This course will provide veterinary and graduate students with practical skills for animal welfare assessment and evaluations using scientific evidence through peer-reviewed literature. Students will learn general criteria and a scientific approach to assess welfare across multiple species and settings. This course is open to students enrolled in the veterinary professional program. In addition, graduate students wishing to compete in the Intercollegiate Animal Welfare Judging Contest may be enrolled in the course based on instructor discretion. Participation in the Intercollegiate Animal Welfare Judging Contest is not a requirement for this course.

Prerequisites: VMP 916F and VMC 927. VMC 927 may be waived with instructor permission
Typically offered in Fall only

VMP 990 Extramural Experiences - Large Animal (2 credit hours)
Senior DVM students will have the opportunity to undertake an elective rotation in an approved practice externship in a large animal practice a) food animal/rural or b) equine/mixed animal. The practice opportunity will meet the need recognized by students, CVM faculty and private practice colleagues alike to increase "hands on" experience in a private practice setting. Private practice experiences are available for year 1 - 3 students through the selective offerings. Presently, senior studentshave the opportunity to experience private practice by arranging an externship as an elective. However, initiating an elective course will ensure consistency between experiences, with clear expectations to achieve an approved level of learning/skills objectives with verification from the practice. Practitioners will be valuable partners in the education process in the senior year, providing access to individual animal and herd-related clinical diversity that is increasingly difficult to offer in the academic setting.

Typically offered in Fall and Spring

VMP 991 SP Top in PHP (1 credit hours)
One week special topic course in the Department of Population Health & Pathobiology Department.

VMP 992 SP Top in PHP (1-2 credit hours)
One week special topic course in the Department of Population Health & Pathobiology Department.

VMP 993 Extramural in Epidemiology, Public Health, and Public Policy (2-6 credit hours)
This course is designed to expand opportunities for senior veterinary students to participate in a 2 week practicum in epidemiology, public health, or public policy under mentorship of experienced State, Federal, or private organization professionals. Students select their area or topic of interest and consult with the Focus Area Leader and submit a short proposal for review. Students work under supervision of an approved professional. Focus Area students may repeat the 2 week experience 3 times for a total of 6 weeks.

Typically offered in Fall and Spring

VMP 994 Extramural Experience in Pathology (1-4 credit hours)
This is a two-week externship experience in pathology. The student will arrange an extramural experience in an academic, diagnostic, government, industrial, or zoological/wildlife labratory setting under the supervision of a board certified veterinary anatomical or clinical pathologist. Fourth year DVM students only.

Typically offered in Fall and Spring

VMP 996 Ruminant Medicine and Surgery Clinical Rotation (1 credit hours)
This is a two-week block focused on medicine and surgery of the ruminant species. During the two-week period, students will stay at the veterinary school, working with the clinicians and house officers on outpatient and inpatient appointments. This two-week block will involve in-clinic experience, focusing on individual animal health management and addressing medical/surgical disorders. Available to senior veterinary students.

Typically offered in Fall, Spring, and Summer

VMP 998 Introduction to Farm Management for Veterinarians (2 credit hours)
This course is an introduction to different aspects of modern beef and dairy farm management. A combination of classroom instruction and practical application, the course will provide future veterinarians with knowledge and skills needed to help producers make informed animal health, production and financial decisions. NCSU CVM Teaching Animal Unit, NCSU Dairy Education Unit, and NCSU Beef Education Unit farms will be used as models for observation and evaluation.

Typically offered in Fall and Spring

VMP 999 Extramural in Vet International Programs (2 credit hours)
This course will provide students with practical experience in a foreign country working on a veterinary medicine related project being conducted in that country. Projects may focus on production medicine, occupational safety, zoological medicine, or basic research.

Typically offered in Fall and Spring

Visual and Performing Arts (VPGE)

VPGE 295 Visual and Performing Arts Special Topics (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts category.

GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Visual and Performing Arts and Glob Know (VPGK)

VPGK 295 Visual and Performing Arts and Global Knowledge Spec Topics (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts and Global Knowledge categories. This course may be used for the Global Knowledge (GK) co-requisite and/or for the Visual and Performing Arts (VPA) requirement.

GEP Global Knowledge, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Visual and Performing Arts and U.S. Div (VPUS)

VPUS 295 Visual and Performing Arts and U.S. Diversity Special Topics (3 credit hours)
Special topics course offering for the general education Visual and Performing Arts and U.S. Diversity categories. This course may be used for the U.S. Diversity (USD) co-requisite and/or for the Visual and Performing Arts (VPA) requirement.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Fall, Spring, and Summer

Women's, Gender and Sexuality Studies (WGS)

WGS 200 Introduction to Women's, Gender, and Sexuality Studies (3 credit hours)
Introduction to Women's, Gender, and Sexuality studies as an interdisciplinary field spanning the humanities, social sciences and natural sciences. Study of historical perspectives and contemporary understanding of women and gender. Theory, systematic analysis, and experiential accounts used to explore complexities of gender, and other identity determinants, mechanisms of power and privilege, and avenues for social change.

GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

WGS 204/SOC 204 Sociology of Family (3 credit hours)
Contemporary American family structures and processes and their development. Focus on socialization, mate selection, marital adjustment and dissolution. Includes core sociological concepts, methods, theories.

GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 210/STS 210 Women and Gender in Science and Technology (3 credit hours)
Interdisciplinary introduction to the reciprocal relationships between scientific/technological research and contemporary understanding of gender. Special emphasis on social factors influencing scientists and engineers in their professions.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall, Spring, and Summer

WGS 215 Abolitionist Futures (3 credit hours)
An interdisciplinary review of domination, oppression, and exploitation in the U.S., this course will introduce feminist theories, abolitionist histories and strategies, and critiques of colonization and capitalism. Abolitionist Futures will use a critical queer lens to generate new possibilities and paradigms for imagining a future beyond policing and incarceration, exploring alternatives such as transformative justice and mutual aid.

GEP Interdisciplinary Perspectives, GEP U.S. Diversity
Typically offered in Fall only

WGS 220 Men and Masculinity (3 credit hours)
An introduction to the study of men and masculinity as an interdisciplinary field spanning the humanities and social sciences. This course will draw on both historical perspectives and contemporary understanding of men and masculinity, with attention to key domains of men's lives such as the roles of men in fiction and film, race and masculinity, religion and masculinity, fatherhood, masculinity and sports, and male sexuality.

GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 293 Special Topics in Women's, Gender, and Sexuality Studies (3 credit hours)
Examination of varying topics on women and/or gender from an interdisciplinary perspective at an introductory level.

Typically offered in Fall and Spring

WGS 300 Introduction to Feminist Theories (3 credit hours)
This course provides an overview of primarily US and western feminist theoretical perspectives by focusing on the variety of viewpoints within feminism and their specific historical roots. More than half of the course is devoted to studying specific themes and issues in women's history. The historical background lays the foundation for examining specific feminist theories, including liberal feminism, difference feminism and black feminism/womanism. The course prepares students for further work in Women's and Gender Studies, including WGS 492.

Prerequisite: WGS 200
Typically offered in Fall only

WGS 304/SOC 304 Gender and Society (3 credit hours)
A sociological analysis of women and men in contemporary American society. Perpetuation of and change in gender stratification using sociological concepts, theories, and research. How gender expectations developed and transmitted. Historical data and research on diversity in American society used for analysis of causes and consequences of gender inequality.

P: 3 credits in SOC at the 200-level
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 305/ENG 305 Women and Literature (3 credit hours)
Nineteenth through twenty-first century women's literature, as shaped by the intersecting and competing claims of gender, race, sexuality, and culture. Focus on fiction, accompanied by critical readings from American studies, feminist literary criticism, and postmodern theory.

Prerequisite: Sophomore standing and above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 306/PS 306 Gender and Politics in the United States (3 credit hours)
This course explores the role of gender in contemporary American politics. The course examines the historical course of gender politics to see how we have arrived at the present state. It investigates the activities that women and men play in modern politics-voting, running for office, serving in office, etc., and how women and men perform these activities in different ways. The course also focuses on major areas of public policy that affect women and men in different ways.

Prerequisite: PS 201
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall only

WGS 308/ENG 308 Contemporary Issues in Ecofeminism (3 credit hours)
Contemporary issues in ecofeminism provides a historical introduction to and global perspectives on women's sociopolitical, ethical, and economic contributions to the 20th and 21st century environmental movement. Theory and political action as they interweave issues of gender, race, and class in western and non-western contexts will be emphasized. Students will read works by and about female scientists/activists/ writers and examine their own communities, analyzing the ways that individuals, community values, and dominant institutions impact women's relationships with the environment. Students will formulate questions, responses, and interpretations through critical reading practices, class discussion groups, self-reflective writing, and comparative analyses. Special attention will be paid to the role of literature--memoir, novel, short story, essay--in the dissemination of ecofeminist ideas.

GEP Humanities, GEP Interdisciplinary Perspectives
Typically offered in Spring only

WGS 310 Women's, Gender, and Sexuality Studies Internship (3 credit hours)
Internship program. Introduction to careers that deal specifically with women's issues. Ten-hours-per-week work at a nonprofit or governmental organization. Contextualization of that experience through additional academic requirements. Individualized/Independent Study and Research courses require a Course Agreement for Students Enrolled in Non-Standard Courses be completed by the student and faculty member prior to registration by the department.

Typically offered in Fall and Spring

WGS 327/ENG 327 Language and Gender (3 credit hours)
Introduction to the use of language by men and women. Research in Linguistics and Women's Studies addressing issues such as the acquisition of gender-differentiated language, gender and conversational interaction, sexism in language, gender issues in society, and the relationship between language, gender, and other social constructs (e.g., class, culture, and ethnicity).

Prerequisite: ENG 101
Typically offered in Fall only

WGS 330 Women and Health (3 credit hours)
Women and Health utilizes an interdisciplinary approach to explore historical perspectives on health, access to health technologies, health policy research, and emerging topics in women's health. The humanities, social sciences, and biological sciences inform inquiry into "hot topics" in health policy, ethics, and the medical sciences. The health of women is dissected through a lens of gender equity and domestic and international perspectives are employed. Students are encouraged to identify and study topics of their own interest.

GEP Interdisciplinary Perspectives
Typically offered in Fall, Spring, and Summer

WGS 350 Emerging Issues in Women's, Gender, and Sexuality Studies (3 credit hours)
Exploration of advanced specialized topics in Women's and Gender Studies, to enhance in-depth undergraduate training in specific applied theories and methods. Seminar content will rotate, with attention to contemporary theoretical currents, and their application and effectiveness in addressing important emerging issues affecting individuals' well-being in society, particularly those faced by underrepresented groups.

Prerequisites: WGS 200 or WGS 210 or STS 210
Typically offered in Fall, Spring, and Summer

WGS 360/MUS 360 Women In Music (3 credit hours)
The role of women in music as patrons, teachers, composers, and performers, placing them within the social, economic, and political framework to which they belong. Emphasis on Western Art Music and the role of women in popular music. No previous formal training in music is required.

GEP U.S. Diversity, GEP Visual and Performing Arts
Typically offered in Spring only

WGS 362/COM 362 Communication and Gender (3 credit hours)
Effects of gender on the interpersonal communication process. Construction of gendered identities via communication practices. Examination of theories of gender and the role of gender in organizational, institutional, and media communication practices.

Prerequisite: Junior standing, COM 112
Typically offered in Fall only

WGS 370 Advanced Studies of Gender in Science (3 credit hours)
This course is designed to provide students with an in-depth view of recent research about the influence of contemporary gender relations on science and engineering. Readings address feminist theories about sex/gender, race/class/sexualities, the social construction of science, and technological innovation. Discussions will focus on scholarship that explores how, why, and when a "gender lens" brings value to understanding nature and knowledge.

Prerequisites: WGS 200 or (WGS 210 or STS 210)
GEP Interdisciplinary Perspectives
Typically offered in Spring only

WGS 380/AFS 380 Black Feminist Theory (3 credit hours)
Focused examination of Black feminist theory as a significant and distinct body of work. Interdisciplinary exploration of the impact of Black feminist theory on movements for social justice, the development of academic feminism generally, and the lived experience of Black women both in the United States and internationally.

Prerequisite: Any 200-level course in either WGS or AFS
GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 390 Queer Theory (3 credit hours)
Queer Theory provides an overview of the writings, art, identity/ies, work, politics, debates, histories, bodies, intimacies, kinship, and other lived realities of the people and experiences often organized under the LGBTQIA+ umbrella. As a critical theory, queer theory examines how circulations of power, dominance, and oppression constantly re/vision what it is to be queer, queering, and queered. The course will focus on how gender, race, class, functional diversity, sexuality, work, documentation status, age, etc. impact and are impacted by queer becoming.

P: Any 3-credit 200-level WGS course.
GEP Humanities
Typically offered in Fall and Summer

WGS 393 Special Topics in Women's, Gender, and Sexuality Studies (3 credit hours)
Special topics in Women's, Gender, and Sexuality Studies at the 300 level for offering courses on an experimental basis.

Typically offered in Fall, Spring, and Summer

WGS 406/PSY 406 Psychology of Gender (3 credit hours)
This course is designed to introduce students to the origins and significance of the study of gender differences and gender relations from a psychological perspective. The course focuses on current theory and research on perceived and actual biological, social, cognitive, personality and emotional similarities and differences of men and women throughout the lifespan as well as the construction and meaning of gender in our society.

Prerequisite: PSY 200 or WGS 200
GEP Social Sciences, GEP U.S. Diversity
Typically offered in Fall and Spring

WGS 407/SOC 407 Sociology of Sexualities (3 credit hours)
Exploration of sexuality in a social context. Relationship between sexuality, gender and power in the U.S. Historical trends in behaviors and identities: social movements and sexual issues; current behavioral trends. Some issues covered; identity, social construction, sexual meanings.

Prerequisite: 3 hours SOC 200 level, 300 level
Typically offered in Spring only

WGS 410/ENG 410 Studies in Gender and Genre (3 credit hours)
This course examines the ways in which women writers from diverse backgrounds have revised the literary genres to include the varied experiences of women. It will focus on a different generic area, such as poetry, fiction, drama or autobiography, depending on its instructor.

Requisite: Sophomore Standing or Above
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

WGS 418/PS 418 Gender Law and Policies (3 credit hours)
Law and policy pertaining to contemporary gender issues. Examination of agenda setting, policy formation, implementation, judicial interpretation and evaluation of selected issues, such as reproductive policies, equal employment and sexual abuse.

Prerequisite: 3 hours of Political Science
GEP U.S. Diversity
Typically offered in Spring only

WGS 444/ANT 544/WGS 544/ANT 444 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

WGS 447/HI 547/WGS 547/HI 447 Women in America: From Contact to the Civil War (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

WGS 448/HI 548/WGS 548/HI 448 American Women in the Twentieth Century (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

WGS 472/REL 472 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: one course in religious studies or women's and gender studies
GEP Humanities
Typically offered in Spring only

WGS 473/REL 573/WGS 573/REL 473 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for more than one of: REL 473, REL 573, WGS 473, WGS 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS). Credit is not allowed for more than one of REL 473, WGS 473.
Typically offered in Fall only

WGS 492 Theoretical Issues in Women's, Gender, and Sexuality Studies (3 credit hours)
Examination of feminist theory. Study of formative texts in modern feminism, drawn from various disciplines within the humanities, social sciences, and natural sciences. In-depth exploration of feminist perspectives on issues of race, class, gender, sexuality, work and mothering, among others. Analysis of local and global cultural practices using feminist theoretical frameworks.

Prerequisite: WGS 200
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

WGS 493 Special Topics in Women's, Gender, and Sexuality Studies (3 credit hours)
Examination of varying topics on women and/or gender from a multidisciplinary perspective.

Typically offered in Fall only

WGS 540/ECD 540 Gender Issues In Counseling (3 credit hours)
Exploration of gender as primary identity and social construct. Emphasis on gender dynamics in counseling, client empowerment and preventive approaches.

Prerequisite: Graduate standing or Six hrs. in ED or PSY
Typically offered in Spring and Summer

WGS 544/ANT 444/WGS 444/ANT 544 Cross-Cultural Perspectives on Women (3 credit hours)
Comparison of women in a variety of societies: western and non-western; hunting and gathering to industrialized. Cross-cultural perspective on the similarity and diversity of women's statuses and roles. Effect of gender on social position

Prerequisite: ANT 252 and one of the following: ANT 310,325,330 or 346
Typically offered in Spring only

WGS 547/HI 447/WGS 447/HI 547 Women in America: From Contact to the Civil War (3 credit hours)
The historical experience of women in America from Native American and European contact through the colonial period to the immediate post-Civil-War years (to 1890). Topics include the history of women's work, education, legal and political status, religious experience, and sex roles, with consideration of age, class, race, sexual preference, and region as significant variables in women's experience in America. Credit will not be given for both HI (WGS) 447 and HI (WGS) 547.

P: 3 Hours of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Fall only

WGS 548/HI 448/WGS 448/HI 548 American Women in the Twentieth Century (3 credit hours)
Women's historical experience in America, 1890-1990. Changes in women's work, education, legal and political status, and sex roles, age, class, race, sexual preference and region as significant variables in women's experience. Credit will not be given for both HI (WGS) 448 and HI (WGS) 548.

P: 3 hrs. of History
GEP Humanities, GEP U.S. Diversity
Typically offered in Spring only

WGS 572/REL 572 Women and Religion (3 credit hours)
Historical, literary, and theological sources dealing with portrayals of women and women's religious experience in several religious traditions of the world through different historical periods, from ancient to modern. Impact of feminist theory on the academic study of religion; methodological issues surrounding the study of women's religious history; role of religion in shaping attitudes toward women and their status in society. Students cannot receive credit for both REL/WGS 472 and REL/WGS 572.

Prerequisite: Graduate Standing
Typically offered in Spring only

WGS 573/REL 473/WGS 473/REL 573 Religion, Gender, and Reproductive Technologies (3 credit hours)
Examines comparative religious ethics concerning gender marriage, parenthood, children, and the relationship of human beings to the "natural". Relates these views to new and emerging reproductive and genetic technologies. Compares the internally diverse perspectives of three major religious traditions with regard to their interpretations of these technologies. Analyzes the impact of particular uses of these technologies on the rights of women and girls. Students cannot earn credit for more than one of: REL 473, REL 573, WGS 473, WGS 573.

Prerequisite: One 3 cr course in Philosophy (PHI) or Religious Studies (REL) or Women's and Gender Studies (WGS). Credit is not allowed for more than one of REL 473, WGS 473.
Typically offered in Fall only

WGS 593 Special Topics (1-6 credit hours)
Examination of a core topic on women and/or gender from an interdisciplinary perspective at the graduate level.

Typically offered in Fall and Spring

WGS 633 Independent Study (1-3 credit hours)
Typically offered in Summer only

WGS 706/PSY 706 Psychology of Gender (3 credit hours)
Current theory and research on perceived and actual biological, social, cognitive, personality, and emotional similarities and differences of men and women throughout lifespan. Construction and consequences of gender in our society and others.

Typically offered in Fall and Spring

WGS 737/SOC 737 Sociology Of Gender (3 credit hours)
Theories about the development and maintenance of gender. Historical development of gender stratification. How individuals "do gender" in their daily lives. Contemporary research and substantive readings about gender in public and intimate relationships.

Prerequisite: Graduate student, SOC 736 or 731
Typically offered in Fall only

WGS 739/SOC 739 Social Psychology Of Inequality (3 credit hours)
The effects of race, class and gender inequality on the formation of group consciousness, self-evaluations, emotions, values, attitudes and beliefs. Attention to interpersonal processes through to reproduction of inequality in everyday life.

Requisite: Admission to SOC Graduate Program
Typically offered in Spring only

Wood and Paper Science (WPS)

WPS 201 Sustainable Materials for Green Housing (2 credit hours)
The overall goal of the class is to make the students more informed and aware consumers of materials used in housing. The class will connect the economic and energy impacts of producing common materials with the environmental impacts, e.g., carbon, water, and pollutants. The concepts of embodied energy, water use, and land impacts will be used to examine common building materials. The concept of Life Cycle Analysis will be introduced and used to evaluate the use and trade-offs for different building materials. The opportunities and trade-offs for reuse and recycling materials at the 'end of life' will also be explored.

GEP Interdisciplinary Perspectives
Typically offered in Spring only

WPS 491 Special Topics in Wood and Paper Science (1-4 credit hours)
Independent study of management or technology problems selected with faculty approval or the offering of experimental courses.

Typically offered in Fall, Spring, and Summer

Zoology (ZO)

ZO 233 Human-Animal Interactions (3 credit hours)
This course is designed to explore the relationship humans share with other animals and nature. We will study the early history of animal domestication and the influence of animals on human culture and religion. We will also explore our relationships to animals as pets, food, research subjects, and wildlife. All subjects will be covered through interaction with quest speaker, assigned readings, case studies, and class discussion.

GEP Interdisciplinary Perspectives
Typically offered in Fall and Summer

ZO 250 Animal Anatomy and Physiology (4 credit hours)
Roles of physical laws, environmental challenges, and evolutionary history in shaping animal structure and function. Selected examples from invertebrates and vertebrates. Laboratory in anatomy and physiology, hypothesis generation and testing and data analysis and presentation.

Prerequisite: C- or better in BIO 183
Typically offered in Fall only

ZO 317 Primate Ecology and Evolution (3 credit hours)
A comprehensive survey of the behavior, evolution, and ecology of nonhuman primates. Special emphasis will be placed in the evolution of cognitive abilities, social systems, and behavioral patterns that are unique to primates, including the evolution of language. Topics include primate taxonomy, evolution of the extant primates, geographic distribution, social behavior, reproductive behavior and strategies, parental behavior, communication, and cognitive. Classes will consist of interactive lectures, films, and class discussions.

Prerequisite: C- or better in BIO 181 & BIO 183, and one of the following courses: ANT 251, BIO 212, BIO 240, BIO 245, BIO 250, BIO/PB 330, BIO 350, BIO/PB 360, BIO 410 , BIO 422, BIO 424, or BIO 488
Typically offered in Spring only

ZO 333 Captive Animal Biology (3 credit hours)
This course serves to introduce interested students to historical and current captive animal conservation efforts. We will discuss in detail a variety of issues essential to the management of wild animals in a captive setting including ethics, nutrition, reproduction, behavior, and population management.

Prerequisite: C- or better in BIO 181 and one of the following (BIO 140 or 250 or 260 or 350 or NTR 301 or ANS 150 or 205 or GN 311)
Typically offered in Spring only

ZO 334 Captive Animal Biology Field Laboratory (2 credit hours)
This laboratory course serves to introduce interested students to today's captive animal conservation efforts from the perspective of NC facilities on the front lines. Through the lens of these nearby institutions, we will investigate in detail a variety of factors essential to the management of wild animals in a captive setting. We will take topics (history, population management, genetics, nutrition, education, conservation) from the lecture course and expand them as we focus on challenges unique to these local captive facilities. While some activities will take place on campus, a number of off-campus field trips are required, including one 3-day laboratory at North Carolina Zoo. We will return to campus most days within the scheduled time frame, however students should plan for the possibility that labs may go overtime on some occasions.

Prerequisite: C- or better in BIO 181; Co-requisite: ZO 333; Sophomore standing and above.
Typically offered in Spring only

ZO 350 Animal Phylogeny and Diversity (4 credit hours)
Phylogenetic history and adaptive radiation of animals; contrast of environmental determinants of biodiversity in tropical and polar regions; modern approaches to phylogeny; role of humans in influencing biodiversity. Students may not receive credit for both ZO 350 and BIO 140 or ZO 402.

Prerequisite: A grade of C- or better in BIO 181 and sophomore standing. Credit is not allowed for both ZO 350 and ZO 402/
Typically offered in Spring only

ZO 402 Invertebrate Biology (4 credit hours)
Over 90% of all animals are invertebrates, and many invertebrate species have proven extremely useful in medical and research applications. This course will survey invertebrate groups or clades (excluding the Protista), and will emphasize their functional biology, phylogeny, ecology, behavior, and use as models in research. Lab will emphasize an experimental approach and will involve work primarily with live material. Students may not receive credit for both ZO 402 and ZO 350.

Prerequisite: A grade of C- or better in BIO 181 and BIO 183. Credit is not allowed for both ZO 402 and ZO 350.
Typically offered in Fall only

ZO 410 Introduction to Animal Behavior (3 credit hours)
Studies in animal behavior in vertebrates and invertebrates, focusing on the mechanisms and evolution of animal behavior. Topics include neural, hormonal, and genetic bases of behavior; foraging; anti-predator defenses; mating systems and sexual selection; social behavior; communication; parental care; territoriality and habitat selection.

Prerequisite: C- or better in BIO 181and BIO 183
Typically offered in Fall and Summer

ZO 486 Capstone Course in Zoology (3 credit hours)
Topical problems in zoology. BIO 486 provides a challenging opportunity for students to integrate and apply knowledge and skills gained from their major studies. Emphasis will be placed on collaborative learning and effective, professional communication. Topics and instructors will vary from semester to semester. Priority will initially be given to seniors in the SZO curriculum; other students with the necessary prerequisites will be admitted on a space available basis.

Prerequisite: C- or better in BIO 250, BIO/PB 360, and one of the following: BIO 350 or BIO 402/403 or GN 311 or ST 311.
Typically offered in Fall and Spring

ZO 524/PHY 524/PO 524 Comparative Endocrinology (3 credit hours)
Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction.

Prerequisite: BIO 421 or PO 405
Typically offered in Spring only

ZO 582/ENT 582 Medical and Veterinary Entomology (3 credit hours)
The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control.

Prerequisite: ENT 425 and ZO 315
Typically offered in Spring only

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