

ADMINISTRATION

UNIVERSITY GOVERNANCE AND ADMINISTRATION

The University is governed by a board of 13 members, six selected by the state Legislature and seven self-perpetuating life members, in accord with the will of Thomas Green Clemson. The Board of Trustees is primarily responsible for adopting the long-range objectives of the University and the basic policies for achieving them; providing policy instruction for long-range planning; adopting the statutes of the University; electing the president of the University; employing the secretary of the board; maintaining ownership of University assets; and overseeing the evaluation of the University.

The president is the chief executive officer of the University, providing leadership to all phases of University planning, coordinating the operations of all units of the University, carrying out major University public relations functions, evaluating the results of University plans, and appointing personnel who report to the president. The day-to-day operations of the University are administered by the president and executive officers for advancement, public service and agriculture, student affairs, and Research and Economic Development.

The Provost and Vice President for Academic Affairs is the chief academic officer of the University. The Provost is responsible directly to the president for all academic matters and has administrative jurisdiction over teaching and computing services. Vice provosts assist in administering and performing duties in coordinating graduate and undergraduate curricula; supervising computer information services, the libraries, scholarship and award programs; and other duties assigned by the Provost.

Academic deans are the chief administrative officers of their individual colleges and report directly to the Provost. They provide leadership in formulating and carrying out educational policy, review and make recommendations on personnel matters, and carry out and administer the academic and financial affairs of their colleges.

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GENERAL INFORMATION

PURPOSE OF CATALOG

The purpose of this catalog is to give a general description of Clemson University and to provide prospective students with detailed information regarding the various colleges and departments within the University and curricula offered by the University. Inasmuch as the educational process necessitates change, the information and educational requirements in this catalog represent a flexible program which may be altered where such alterations are thought to be in the mutual interest of the University and its students.

The provisions of this catalog do not constitute a contract which may be accepted by students through registration and enrollment in the University. The University reserves the right to change without notice any fee, provision, offering, or requirement in this catalog and to determine whether a student has satisfactorily met its requirements for admission or graduation. The University further reserves the right to require a student to withdraw from the University for cause at any time.

Each plan of study shall be governed by the requirements in effect on the date of enrollment. If a student withdraws from the University and subsequently returns or does not remain continuously enrolled (summers excluded), the requirements in effect at the time of return will normally prevail.

VISION STATEMENT

Clemson University will be one of the nation's top 20 public universities.

MISSION STATEMENT

The mission of Clemson University is to fulfill the covenant between its founder and the people of South Carolina to establish a "high seminary of learning" through its historical land-grant responsibilities of teaching, research, and extended public service.

Clemson University is a selective, public, land-grant university in a college-town setting along a dynamic southeastern corridor. The University is committed to world-class teaching, research, and public service in the context of general education, student development, and continuing education. Clemson's desire is to attract a capable, dedicated, and diverse student body of approximately 12,000 to 14,000 undergraduate and 4,000 to 5,000 graduate students, with priority to students from South Carolina.

Clemson offers a wide array of high quality baccalaureate programs built around a distinctive core curriculum. Graduate and continuing education offerings respond to the professions, while doctoral and research programs contribute to the economic future of the state, nation, and world. The University emphasizes agriculture, architecture, business, education, engineering, natural resources, science, and technology. The University also promotes excellence in education and scholarship in selected

areas of the creative arts, health, human development, the humanities, and social sciences. In all areas, the goal is to develop students' communication and critical-thinking skills, ethical judgment, global awareness, and scientific and technological knowledge. Students remain the primary focus of the University.

Just as Clemson values its students, the University also values its faculty and staff who have committed their talents and careers to advance its mission. Clemson pledges to support their work, to encourage their professional development, to evaluate their professional performance, and to compensate them at nationally competitive levels.

HISTORY

When one man of wisdom and foresight can look among the despair of troubled times and imagine what could be, great things can happen. That is what the University's founder, Thomas Green Clemson, was able to do in the post-Civil War days. He looked upon a South that lay in economic ruin, once remarking that "conditions are wretched in the extreme" and that "people are quitting the land." Still, among the ashes he saw hope. Joined by his wife, Anna Calhoun Clemson, Mr. Clemson envisioned what could be possible if the South's youth were given an opportunity to receive instruction in scientific agriculture and the mechanical arts. He once wrote, "The only hope we have for the advancement of agriculture (in the U.S.) is through the sciences, and yet there is not one single institution on this continent where a proper scientific education can be obtained." When he was president of the Pendleton Farmers Society in 1866, Mr. Clemson served on a committee whose purpose was to promote the idea of founding an institution for "educating the people in the sciences" and "which will in time secure permanent prosperity."

When he died on April 6, 1888, a series of events began that marked the start of a new era in higher education in the state of South Carolina, especially in the study of science, agriculture, and engineering. Mr. Clemson's passing set the stage for the founding of the university that bears his name—the beginning of a true "people's university," which opened the doors of higher education to all South Carolinians, rich and poor alike. In his will, which was signed November 6, 1886, Mr. Clemson bequeathed the Fort Hill plantation and a considerable sum from his personal assets for the establishment of an educational institution of the kind he envisioned. He left a cash endowment of approximately \$80,000 as well as the 814-acre Fort Hill estate to South Carolina for such a college. The biggest obstacle in the creation of an agricultural college—the initial expense—was removed by Mr. Clemson's bequest.

On November 27, 1889, Governor Richardson signed the bill accepting Thomas Clemson's gift. Soon after a measure was introduced to establish the Clemson Agricultural College, with its trustees becoming custodians of Morrill Act and Hatch Act funds made available for agricultural education and research by federal legislative acts. The founding of Clemson Agricultural College supplanted the South Carolina College of Agriculture and Mechanics, which had been designated in Columbia in 1880.

Thomas Green Clemson came to the foothills of South Carolina when he married Anna Maria Calhoun, daughter of South Carolina's famous statesman John C. Calhoun.

Born in Philadelphia, Mr. Clemson was educated at schools both in the United States and France, where he attended lectures at the Royal School of Mines, studied with prominent scientists in the private laboratories of the Sorbonne Royal College of France, and received his diploma as an assayer from the Royal Mint in Paris. Mr. Clemson, then in his mid-20s, returned to America greatly influenced by his European studies. He became a great advocate of the natural sciences, achieving a considerable reputation as a mining engineer and a theorist in agricultural chemistry. He also was a gifted writer whose articles were published in the leading scientific journals of his day, an artist and a diplomat who represented the U.S. government as chargé d'affaires to Belgium for almost seven years.

Mr. Clemson had a lifelong interest in farming and agricultural affairs. He served as the nation's first superintendent of agricultural affairs (predecessor to the present secretary of agriculture position) and actively promoted the establishment and endowment of the Maryland Agricultural College in the 1850s. Though remembered today for these accomplishments, Thomas Clemson made his greatest historical contribution when, as a champion of formal scientific education, his life became intertwined with the destiny of educational and economic development in South Carolina. Although he never lived to see it, his dedicated efforts culminated in the founding of Clemson Agricultural College.

At the time of his death, Mr. Clemson was living at the Fort Hill homeplace, which today is a national historic landmark and provides a historic centerpiece for the Clemson University campus. He had inherited the house and plantation lands of his famous father-in-law, Senator Calhoun, upon the death of Mrs. Clemson in 1875.

Clemson College formally opened in July 1893, with an enrollment of 446. From the beginning, the college was an all-male military school. It remained this way until 1955, when the change was made to "civilian" status for students, and Clemson became a coeducational institution. In 1964, the college was renamed Clemson University as the state legislature formally recognized the school's expanded academic offerings and research pursuits.

On November 27, 1989, the University observed the 100th anniversary of the State's acceptance of the terms and conditions of Mr. Clemson's bequest.

The enrollment of Clemson has grown from 446 students at the opening of the University to 17,585 for the first semester 2007-2008. Of this number, 3,315 were graduate students (2,096 full-time and 1,219 part-time graduate students). Since the opening of the University, 102,484 students have been awarded Bachelor's degrees. During this same period, 426 Associate degrees, 28,221 Master's, 350 Education Specialist, and 3,014 Doctor's degrees have been awarded, a total of 134,495 degrees.

Today, more than a century later, the University is much more than its founder ever could have imagined. With its diverse learning and research facilities, the University provides an educational opportunity not only for the people of the State, as Mr. Clemson dreamed, but for thousands of young men and women throughout the country and the world.

THE CAMPUS

The 1,400-acre University campus is sited on the former homestead of statesman John C. Calhoun. Nestled in the foothills of the Blue Ridge Mountains and adjacent to Lake Hartwell, the campus commands an excellent view of the mountains to the north and west, some of which attain an altitude of over 5,000 feet above mean sea level.

The Norfolk and Southern Railway and U.S. Highways 76 and 123 provide easy access to the City of Clemson and to the University. Oconee County Airport is four miles from the library. Both Atlanta and Charlotte are two hours driving time away.

Campus architecture is a pleasing blend of traditional and modern facilities enhanced by a beautiful landscape of towering trees, grassy expanses, and flowering plants. Academic, administrative, and student service buildings on campus represent an insured value of \$627 million. Clemson University's real estate holdings include over 32,000 acres of forestry and agricultural lands throughout the state, the majority of which are dedicated to Clemson's research and public-service missions.

Fort Hill, the former home of John C. Calhoun inherited by Thomas Clemson, and the Hanover House are listed on the National Register of Historic Places and are open to the public. The campus also has two recognized Historic Districts.

The Strom Thurmond Institute houses the institute offices, Senator Thurmond's papers and memorabilia, and the special collections of the Cooper Library, including papers of John C. Calhoun and James Byrnes, the most important South Carolinians since 1787. The Institute is a part of an instructional and public-service district that includes the Brooks Center for the Performing Arts and the Madren Center for Continuing Education. In addition, the University offers limited graduate and undergraduate coursework in Greenville, SC, and is building a graduate and research center, the International Center for Automotive Research (ICAR), also in Greenville.

ACCREDITATION

Clemson University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award the Bachelor's, Master's, Education Specialist, and Doctor's degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, GA 30033-4097 or call 404-679-4500 for questions about the accreditation of Clemson University.

Curricula are accredited by AACSB International (Association to Advance Collegiate Schools of Business), Accreditation Board for Engineering and Technology, American Council for Construction Education, American Dietetic Association (CADE), American Society of Landscape Architects, Commission on Collegiate Nursing Education

(CCNE), Council for Accreditation of Counseling and Related Education Programs (CACREP), National Architectural Accrediting Board, National Association of Schools of Art and Design, National Council for Accreditation of Teacher Education, NRPA/AALR Council on Accreditation, Planning Accreditation Board, and Society of American Foresters. Documentation of accreditation is available in the college deans' offices.

CAMPUS VISITS AND TOURS

One of the best ways to discover all Clemson has to offer is through a visit to the campus. The Class of 1944 Visitors Center helps host prospective students' Clemson experience. Information, audio-visuals, parking passes, and tours are all easily accessible. The Visitors Center is located just off of Highway 93 adjacent to the Alumni Center. Normal hours of operation are Monday–Friday, 8:00 A.M.–4:30 P.M.; Saturday, 9:00 A.M.–4:30 P.M.; and Sunday, 1:00–4:30 P.M. Hours vary according to the academic calendar, University holidays, and the home football schedule.

Walking tours, guided by volunteer student members of the University Guide Association, are available at 9:45 A.M. and 1:45 P.M. Monday–Saturday and 1:45 P.M. on Sundays. Tour schedules also vary based on the academic calendar, University holidays, and the home football schedule. Tours are conducted rain or shine, last about two hours, and include an information segment at the beginning. Reservations are highly recommended and can be arranged on-line at www.clemson.edu/visitors/index.html or by calling 864-656-4789.

CAREER CENTER

The Michelin® Career Center assists undergraduate and graduate students in selecting an appropriate field of study, furthering their education, and/or learning effective job searching strategies as well as making connections with employers.

Students can utilize a complete range of services and career development resources in the career library in both print and electronic formats. Career counselors are available to meet one-on-one with students to explore career or education options, devise résumés and cover letters, hone interviewing techniques, conduct searches for internships and full-time jobs, and ready themselves for interviewing with employers on campus. In addition, students may utilize ClemsonJobLink, the Career Center's on-line recruiting system, to view part-time jobs, internships, and full-time job positions and to sign up for on-campus interviews.

For students in programs that do not offer internship credit, the Career Center offers zero-credit-hour internships courses (CCINT). Students may participate in either a part-time or full-time internship.

Major events sponsored by the Career Center include a fall and spring Career Fair and University Placement/Recruitment for Educators Program (UPREP) Teacher Fair.

Information is available from the Career Center at career.clemson.edu or by calling 656-6000.

COMPUTING RESOURCES

Clemson Computing and Information Technology (CCIT) supports the computing needs of students and employees with comprehensive services including laptop support, training, printing, computer repair, software licenses, wireless access points, network and information security, course management system, and more.

CCIT also maintains numerous computer labs throughout the campus, five of which are public access. The labs contain high-end PCs running Windows XP and laser printing equipment. Students have access to the Internet, e-mail, Google Apps for Education, and Microsoft Office Suite, which includes Word, Excel, and PowerPoint applications.

CCIT provides computer training and support to faculty, staff, and students in the use of the MyCLE portal and the Web-based course management system (Blackboard), the Clemson computer network, e-portfolios, and many desktop applications. Training is offered as part of regular University courses, through short courses, through special training programs, and through e-learning courses. Distance-learning processes and technologies are also supported with the goal of enhancing the design, production, and delivery of an increasing number and variety of University distance education courses. On-line registration and a complete list of courses are available from the CCIT Web site at ccit.clemson.edu.

CCIT Customer Support Center

CCIT provides support and consulting in a comprehensive Customer Support Center (CSC) located in the University Union. The CSC serves as a central point of contact for those who need general computing assistance, laptop support, and consulting services. A satellite CCIT Help Desk is located in the Cooper Library on Level 5. This Help Desk can assist students in the use of hardware, software, and services. Students and employees may call 656-3494, send e-mail to ITHELP@clemson.edu, or check the information and hours of desk operations on the Web at ccit.clemson.edu.

Wireless Access

The campus computer network can be accessed through wired network connections found in all on-campus residences or through the University's extensive wireless network. This wireless access network provides coverage to most areas of Clemson's campus. Students wishing to connect to the wireless network are encouraged to buy a wireless card with Cisco certified extensions. More information and complete coverage details, including a list of compatible wireless cards, can be found on the CCIT Web site.

Security

Clemson University requires all users to run virus protection and install the latest operating system patches on their computers. Clemson has a site license for the McAfee products, VirusScan (Windows), and Virex (MacOS). These are located on the Software Archive at download.clemson.edu.

Laptop Program

All Clemson University MBA graduate students are required to have laptops. While students may bring any laptop that meets the minimum specifications, recommended laptops are posted at laptop.clemson.edu. Clemson University has worked with vendors to offer recommended laptops at special discounted prices. Students using the recommended laptops will receive both software and hardware support. Limited support is also offered to students who have non-recommended laptops.

As part of the CCIT Customer Support Center services, student employees are available to perform diagnostics and software assistance on laptops. Repair technicians are on hand to do warranty repairs on the recommended Clemson laptops, and many spare parts for these laptops are kept in stock. Students whose laptops must be in PC Repair for an extended period of time may check out a loaner laptop, subject to availability. Only students who have one of the recommended laptop models in for repair may take advantage of the loaner service; however, many other brands of computers can also be serviced and repaired.

Additional information is available at ccit.clemson.edu or by e-mail from ITHELP@clemson.edu.

DISABILITY SERVICES

Student Disability Services coordinates the provision of reasonable accommodations for students with physical, emotional, or learning disabilities. Accommodations are individualized, flexible, and confidential based on the nature of the disability and the academic environment in compliance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990.

Students are encouraged to consult with the Disability Services staff early in the semester, preferably prior to the first day of class. Current documentation of a specific disability from a licensed professional is needed. Additional information or appointments are available from Student Disability Services, G-23 Redfern Health Center, 656-6848. Details on policies and procedures are available at www.clemson.edu/asc.

GENERAL UNIVERSITY POLICIES

Extensive and detailed policy information is available in the *Student Handbook* at www.clemson.edu/studentaffairs/studenthandbook/.

ENGLISH FLUENCY

Clemson University has established a policy to assure that all instructional activities are conducted by individuals possessing appropriate proficiency in written and oral use of the English language. Instructional activities include lectures, recitation or discussion sessions, and laboratories. The individuals to be certified include full-time and part-time faculty, graduate teachers of record, graduate teaching assistants, and graduate laboratory assistants for whom English is not the first language.

A student who experiences difficulty with an instructor's written or oral English and who wishes to seek relief must do so prior to the seventh meeting of a 50-minute class and prior to the fifth meeting of a 90-minute class in regular semesters. In the five-week summer sessions, relief must be sought prior to the third class meeting.

The procedure is summarized as follows:

a. The student must quickly bring the problem to the attention of the instructor's department chair either directly or through a faculty member such as the student's advisor. That department chair will assess the complaint and, if deemed valid, offer an appropriate remedy within two days.

b. A student who is not satisfied with the department chair's decision or the relief suggested, may appeal within two days to a five-member hearing panel comprised of three faculty members and two students appointed by the Senior Vice Provost and Dean of Undergraduate Studies.

Students with questions should contact the Associate Dean of Undergraduate Studies, E-103 Martin Hall.

EQUAL OPPORTUNITY/AFFIRMATIVE ACTION

Clemson University, in compliance with Titles VI and VII of the Civil Rights Act of 1964, as amended, Title IX of the Education Amendments of 1972, and Sections 503 and 504 of the Rehabilitation Act of 1973, does not discriminate on the basis of race, color, national origin, religion, sex, or disability in any of its policies, procedures, or practices; nor does the University, in compliance with the Age Discrimination in Employment Act of 1967, as amended, and Section 402 of the Vietnam Era Veterans Readjustment Act of 1974, discriminate against any employees or applicants for employment on the basis of their age or because they are disabled veterans or veterans of the Vietnam era. Clemson University conducts its programs and activities involving admission, access, treatment, employment, teaching, research, and public service in a nondiscriminatory manner as prescribed by Federal laws and regulations.

In conformance with University policy and pursuant to Executive Order 11246, as amended, Section 503 of the Rehabilitation Act of 1973, and Section 402 of the Vietnam Era Veterans Readjustment Act of 1974, Clemson University is an Affirmative Action/Equal Opportunity Employer.

Inquiries concerning the above may be addressed to the following:

Executive Secretary, Clemson University Board of Trustees, 201 Sikes Hall, Clemson University, Clemson SC 29634

Director, Office for Access and Equity, 207 Holtzen-dorff, Clemson University, Clemson SC 29634

Director, Office for Civil Rights, Department of Education, Washington DC 20201.

INFORMATION RESOURCES FOR STUDENTS

Clemson University computing resources are the property of Clemson University, to be used for university-related business. Students have no expectation of privacy when utilizing university computing resources, even if the use is for personal purposes. The university reserves the right to inspect, without notice, the contents of computer files regardless of medium, the contents of electronic mailboxes and computer conferencing systems, systems output such as printouts, and to monitor network communication when

1. It is considered reasonably necessary to maintain or protect the integrity, security or functionality of university or other computer resources or to protect the university from liability;
2. There is reasonable cause to believe that the users have violated this policy or otherwise misused computing resources;
3. An account appears to be engaged in unusual or unusually excessive activity;
4. It is otherwise required or permitted by law.

Any suspected violations of this policy or any other misuse of computer resources by students normally should be referred to the Office of Student Conduct. That office will investigate the allegations and take appropriate disciplinary action. Violations of law related to misuse of computing resources may be referred to the appropriate law enforcement agency.

Notwithstanding the above, Clemson Computing and Information Technology may temporarily suspend, block or restrict access to an account, independent of university disciplinary procedures, when it appears reasonably necessary to do so in order to protect the integrity, security or functionality of university or other computer resources, to protect the university from liability, or where the emotional or physical well-being of any person is immediately threatened. When CCIT unilaterally takes such action, it will immediately notify the account holder of its actions and the reason for them in writing. The account holder may appeal the action taken by CCIT in writing to the Chief Information Officer.

Access will be restored to the account holder whenever the appropriate investigatory unit of the university determines that the protection of the integrity, security or functionality of university or other computing resources has been restored and the safety and well being of all individuals can reasonably be assured, unless access is to remain suspended as a result of formal disciplinary action imposed through the Office of Student Conduct or as a result of legal action.

Use of University computing resources, including network facilities, account numbers, data storage media, printers, plotters, microcomputer systems, and software for computing activities other than those authorized by the University is strictly prohibited. Unauthorized use of such resources is regarded as a criminal act in the nature of theft, and violators are subject to suspension, expulsion, and civil and criminal prosecution.

Use of university computing resources, including network facilities, account numbers, data storage media, printers, plotters, microcomputer systems, and software for computing activities other than those authorized by the university is strictly prohibited. Unauthorized use of such resources is regarded as a criminal act in the nature of theft and violators are subject to suspension, expulsion, and civil and criminal prosecution.

The following are examples of misuse of computing resources:

1. Unauthorized duplication, distribution or alteration of any licensed software. This includes software licensed by the university and licensed software accessed using the computing networks.
2. Attempting to gain unauthorized access to any computing resource or data, or attempting to disrupt the normal operation of any computing resource or network—at Clemson or anywhere on the Internet,
3. Attempting to use another student's or employee's computer account or data, without their permission.
4. Using the university electronic mail system to attack other computer systems, falsify the identity of the source of electronic mail messages. Sending harassing, obscene or other threatening electronic mail. Attempting to read, delete, copy or modify the electronic mail of others without their authorization. Sending, without official university authorization, "for-profit" messages, chain letters or other unsolicited "junk" mail.
5. Knowingly infecting any computing resource with a software virus.
6. Tampering with the university computer network or building wiring or installing any type of electronic equipment or software that could be used to capture or change information intended for someone else.
7. Participating in a "denial of service" attack on any other computer, whether on or off campus.
8. Using university computing or network resources for personal gain or illegal activities such as theft, fraud, copyright infringement, piracy (e.g., sound or video recording), or distribution of child pornography or obscenities.

PATENTS AND COPYRIGHTS

All students enrolling in Clemson University do so with full understanding that

1. The University has full ownership rights in any inventions, discoveries, developments, and/or improvements, whether or not patentable (inventions), which are conceived, developed, or reduced to practice or caused to be conceived, developed, or reduced to practice by graduate students during the course of their research activities conducted as part of any Graduate School curriculum. Any such invention will be handled by the University in the same manner as set forth in the *Faculty Manual of Clemson University*, the pertinent provision for which appears as Part IXB entitled "Patent Policy."

2. Copyright ownership of any research work will be determined by University policy and by policies of organizations responsible for publishing or distributing copyrighted material.

3. The initial right of students in copyright of ownership is subject to interests retained by Clemson University. The rights retained by Clemson University may be subject to interests of third parties.

Copies of the policies on patents and copyrights are available in the individual departments and colleges and in the Graduate School Office.

REVOCATION OF ACADEMIC DEGREES

Preamble

Academic institutions have a critical responsibility to provide an environment that promotes integrity, while at the same time encouraging openness and creativity among scholars. Care must be taken to ensure that honest error and ambiguities of interpretation of scholarly activities are distinguishable from outright misconduct. This policy is applicable to fraudulent or other misconduct in obtaining an academic degree which is so egregious that a mechanism for revoking an academic degree, either graduate or undergraduate, must be undertaken. The Clemson University Board of Trustees has the sole authority to revoke any degree previously awarded.

Definitions

As used herein, the following terms shall apply:

A. When the degree holder was an undergraduate student:

1. "Dean" shall mean the dean of the academic college where student was enrolled.

2. "Committee of Investigation and Recommendation" shall be composed of the members of the standing University undergraduate Continuing Enrollment Appeals Committee. An undergraduate student will be appointed to the Committee of Investigation and Recommendation by the President of the Student Body within ten (10) calendar days of notification by the President of the Faculty Senate. Any member of the Continuing Enrollment Appeals Committee who is a faculty member in the department which awarded the degree involved shall not be a member of the Committee of Investigation and Recommendation for that particular investigation. If there are fewer than three (3) non-disqualified faculty members, the President of the Faculty Senate shall appoint additional faculty members to bring the number of faculty committee members up to three.

3. If the President of the Faculty Senate is from the same department that awarded the degree involved, the President-Elect of the Faculty Senate shall appoint the additional member.

B. When the degree holder was a graduate student:

1. "Dean" shall mean the Dean of the Graduate School.

2. "Committee of Investigation and Recommendation" shall be composed of the members of the standing University Graduate Admissions and Continuing Enrollment Appeals Committee, ex-

cept for the Associate Dean of the Graduate School who shall not be a member of the Committee of Investigation and Recommendation. A graduate student will be appointed to the Committee of Investigations and Recommendation by the President of Graduate Student Government within ten (10) calendar days of notification by the President of the Faculty Senate. Any member of the Graduate Admissions and Continuing Enrollment Appeals Committee who is a faculty member in the department which awarded the degree involved shall not be a member of the Committee of Investigation and Recommendation for that particular investigation. If there are fewer than three (3) non-disqualified faculty members, the President of the Faculty Senate shall appoint additional faculty members to bring the number of faculty committee members up to three (3). If the President of the Faculty Senate is from the same department that awarded the degree involved, the President-Elect of the Faculty Senate shall appoint the additional member.

Complaint

An allegation or complaint involving the possibility of misconduct can be raised by anyone. The allegation should be made in writing to the dean.

Initial Review

The Dean will conduct the initial review to determine whether or not the allegation has merit. The Dean may discuss the matter with the former student's advisory committee (if any) and other faculty as appropriate. The Dean may also contact persons outside the University who may be able to provide factual information on the alleged misconduct or who may otherwise have expertise concerning issues involved in the alleged misconduct. If the Dean determines that the allegation has no merit, he/she will terminate the investigation. If the Dean determines that serious academic misconduct is suspected, the Dean will notify the President of the Faculty Senate in writing in a confidential manner. The Dean shall also notify the Vice President for Academic Affairs and Provost of the charge but will not discuss any details of the charge.

Committee of Inquiry

The President of the Faculty Senate shall, within ten calendar days of receipt of the notification from the dean, appoint three (3) faculty members to the Committee of Inquiry and notify the President of Graduate Student Government or the President of the Student Body, as appropriate, who shall appoint a graduate or undergraduate student, as appropriate, to the Committee of Inquiry within ten (10) calendar days of notification. The President of the Faculty Senate shall also notify the degree holder of the formation of a Committee of Inquiry.

If the Faculty Senate President is from the same department that awarded the degree involved, the President-Elect of the Faculty Senate shall appoint the Committee of Inquiry. The faculty members will be appointed from departments which did not award the degree involved. The Committee will elect its chairman from the faculty members on the Committee.

For each allegation, the Committee of Inquiry will review the complaint and any other information provided by the dean and determine whether there is sufficient evidence to warrant a formal charge

of academic misconduct and further investigation under this policy. While the Committee of Inquiry shall not make a recommendation as to whether a degree should be revoked, the purpose is to provide a review to separate frivolous, unjustified, or mistaken allegations from those requiring a more detailed and formal investigation. The Committee of Inquiry will review the evidence and must determine that the alleged misconduct more probably than not occurred in order for the committee to recommend a formal charge and further investigation.

Within thirty (30) calendar days of the formation of the Committee of Inquiry, the Committee of Inquiry will submit a written report to the President of the Faculty Senate. If the Committee of Inquiry's report finds that the investigation should not proceed, the President of the Faculty Senate shall terminate the investigation and notify the appropriate persons. If the Committee of Inquiry's report finds that a formal charge and further investigation are warranted, the President of the Faculty Senate shall, within ten (10) calendar days of receipt of the report of the Committee of Inquiry, send a copy of that report to the Dean and to the Committee of Investigation and Recommendation. The President of the Faculty Senate shall also immediately notify the President of Graduate Student Government or President of the Student Body (whichever is appropriate) that a student representative needs to be appointed to the Committee of Investigation and Recommendation. The President of the Faculty Senate shall also notify the Vice President for Academic Affairs and Provost of the Committee of Inquiry's recommendation. No details of the charge will be discussed. *Note:* A majority vote of the Committee of Inquiry is necessary to recommend that a formal charge and further investigation are warranted. A tie vote means that the investigation is terminated as stated herein.

Notification to Degree Holder

The Dean shall issue in writing, within ten (10) calendar days of receipt of the report of the Committee of Inquiry, a formal charge of academic misconduct to the degree holder. This written notice shall detail the factual allegations for the charge and the evidence supporting the charge. This written notice shall also inform the degree holder that if the charges are substantiated, the degree holder's degree could be revoked. This written notice shall also inform the degree holder of his/her right to appear at a hearing as stated in this policy. The Dean shall also send with this notice a copy of this Policy and Procedure on Revocation of Academic Degrees to the degree holder. This notice shall be delivered to the accused in person or sent by certified mail, return receipt requested.

Committee of Investigation and Recommendation

The Committee of Investigation and Recommendation shall extend to the degree holder due process which shall, at a minimum, include the following:

1. notice of the nature of the complaint;
2. notice of the evidence supporting the complaint;
3. notice of the hearing;
4. the opportunity to present evidence, including testimony;
5. the opportunity to hear the testimony against the degree holder;

6. the opportunity to ask questions of all witnesses;

7. the opportunity to have an attorney or advisor present at the hearing; however, the role of the attorney or advisor shall be solely to assist the party, and the attorney or advisor shall not be permitted to participate actively in the proceedings.

The degree holder shall not be entitled to know the identity of the person(s) who originally made the complaint unless that person agrees that his/her identity can be revealed.

The chair of the Committee of Investigation and Recommendation shall inform the degree holder of the time and date of the hearing.

The Dean or his/her designee shall present the accusation against the degree holder at the hearing and may have one additional representative present during the hearing. Under this section the term "Dean" is understood to include the Dean's designee, if such a designation is made.

The degree holder and the Dean may submit written materials to the Committee of Investigation and Recommendation prior to the hearing. The chair of the Committee of Investigation and Recommendation shall make available the materials received to the other party and to all committee members. The hearing before the Committee of Investigation and Recommendation shall be held no sooner than thirty (30) calendar days and no later than ninety (90) calendar days after receipt of the report of the Committee of Inquiry unless the degree holder and the Dean agree to a different date. All matters pertaining to the hearing shall be kept as confidential as possible and the hearing shall be closed to the public. A verbatim record of the hearing will be taken and a type-written copy thereof transcribed and made a part of the hearing record. The degree holder and the Dean shall be responsible for having any witnesses they wish to testify in attendance at the hearing. Witnesses will be present only while testifying.

The chair of the Committee of Investigation and Recommendation shall take whatever action is necessary during the hearing to ensure a fair, orderly, and expeditious hearing. No formal rules of evidence will be followed. If any objection is made to any evidence being offered, the decision of the majority of the committee shall govern. Irrelevant, immaterial, or unduly repetitious evidence shall be excluded.

The degree holder and the Dean shall be permitted to offer evidence and witnesses pertinent to the issues.

The Dean shall present the case against the accused first. The accused shall then present his/her response.

The chair will allow each party to ask questions of the other party and will allow each party to ask questions of the other party's witnesses at the appropriate time during the hearing as determined by the chair. Members of the committee may ask questions of any party or any witness at any time during the hearing.

Within fifteen (15) calendar days of the conclusion of the hearing, the Committee of Investigation and

Recommendation shall submit a written report to the Vice President for Academic Affairs and Provost. The report shall contain findings and a recommendation as to whether the degree holder's degree should be revoked. The Committee of Investigation and Recommendation must find clear and convincing evidence that serious academic misconduct has been committed in order to recommend the revocation of the degree holder's degree. If the Committee of Investigation and Recommendation does not find clear and convincing evidence of serious academic misconduct, the Committee of Investigation and Recommendation cannot recommend revocation of the degree holder's degree and the matter shall be closed. *Note:* A majority vote of the Committee of Investigation and Recommendation is necessary to recommend the revocation of a degree holder's degree. This means that a tie vote will result in the matter being closed.

At the same time that the report is sent to the Vice President for Academic Affairs and Provost, the chair of the Committee of Investigation and Recommendation shall send a copy of the report to the degree holder, the Dean, and other appropriate persons involved in the process.

If the Committee of Investigation and Recommendation recommends that the degree holder's degree be revoked, the chair shall also send a complete copy of the hearing record to the Vice President for Academic Affairs and Provost. The hearing record shall consist of the transcript of the hearing and all documents that were submitted to the committee. The chair of the Committee of Investigation and Recommendation shall label which documents were submitted by each party when forwarding this information to the Vice President for Academic Affairs and Provost.

If the Committee of Investigation and Recommendation recommends that the degree holder's degree be revoked, the chair shall also send a copy of the transcript of the hearing to the degree holder and the Dean at the same time that it is sent to the Vice President for Academic Affairs and Provost.

Vice President for Academic Affairs and Provost

If the Committee of Investigation and Recommendation recommends that the degree be revoked, the Vice President for Academic Affairs and Provost shall review the hearing record and the report of the Committee of Investigation and Recommendation. If the Vice President for Academic Affairs and Provost decides that the degree holder's degree should not be revoked, he/she shall notify the degree holder, the Dean, the Committee of Investigation and Recommendation, and other appropriate persons involved in the process, in writing, within twenty-one (21) calendar days of receipt of the transcript of the hearing; and the matter shall be closed. If the Vice President for Academic Affairs and Provost decides to recommend that the degree holder's degree should be revoked, the Vice President for Academic Affairs and Provost shall send that recommendation in writing to the President of the University within twenty-one (21) calendar days of receipt of the transcript of the hearing. The Vice President for Academic Affairs and Provost shall send to the President, along with his/her rec-

ommendation, the Committee of Investigation and Recommendation's report and the hearing record. The Vice President for Academic Affairs and Provost shall send a copy of his/her recommendation to the degree holder, the Dean, the Committee of Investigation and Recommendation, and other appropriate persons involved in the process.

If the Vice President for Academic Affairs and Provost is disqualified from reviewing the case, the Dean of Undergraduate Studies shall be substituted for the Vice President for Academic Affairs and Provost.

President

If the Vice President for Academic Affairs and Provost recommends to the President that the degree holder's degree should be revoked, the President shall transmit that recommendation along with the report of the Committee of Investigation and Recommendation and the hearing record to the Executive Secretary of the Board of Trustees within thirty (30) calendar days of receipt. If the President wishes to make a recommendation, he/she shall review the recommendation of the Vice President for Academic Affairs and Provost, the report of the Committee of Investigation and Recommendation, and the hearing record and forward his recommendation to the Executive Secretary of the Board of Trustees within thirty (30) calendar days of receiving the recommendation of the Vice President for Academic Affairs and Provost.

Board of Trustees

The Executive Secretary of the Board of Trustees shall send to all trustees the hearing record, the recommendation of the Vice President for Academic Affairs and Provost, the report of the Committee of Investigation and Recommendation, and the recommendation of the President, if any. A majority vote by the Board of Trustees, at a duly constituted Board meeting, is required to revoke an academic degree. The decision of the Board of Trustees shall be final.

Guiding Principles

All actions taken by committees shall be effective by a majority vote.

All investigations, hearings, and actions shall be kept as confidential as possible except for notice of any revocation approved by the Board of Trustees.

A decision not to proceed at any stage of the proceedings set forth in this policy does not necessarily mean that the original complaint was groundless.

For good cause shown, at the request of either party and the approval of the other, the Vice President for Academic Affairs and Provost shall extend any time limit set forth in this policy. Any such time extension shall be communicated in writing to all appropriate parties.

Administrative Action if Degree is Revoked

If a degree is revoked by the Board of Trustees, the former student's transcript will be modified to reflect that the degree was revoked, and the former student will be informed of the revocation and requested to return the diploma. If the former student was enrolled in a program requiring a thesis or dissertation, all bound copies will be removed from the Clemson University Library. In addition, for doctoral students, University Microfilms, Inc. will be notified and requested to take appropriate action.

Students whose degrees have been revoked may be eligible to reapply for admission according to normal University procedures and policies in effect at the time of reapplication.

HOUSING

Graduate Student Housing

On-campus housing for graduate students is available as space permits. Additional information is available from the Housing Office, 200 Mell Hall, Box 344075, Clemson, SC 29634-4075; phone (864) 656-4663.

INTERNATIONAL SERVICES

International Affairs (IA) provides support services to all foreign students and exchange visitors in academic and personal matters relating to their nonimmigrant status (F-1 and J-1) in the United States. IA also serves as the official liaison between the University and the U.S. Department of Homeland Security's Bureau of Citizenship and Immigration Services (USCIS) and the U.S. Department of State. Upon arrival at Clemson University, foreign students and exchange visitors are required by U.S. regulation to report immediately to the Office of International Affairs in E-303 Martin Hall to register their arrival at Clemson with USCIS.

Students

Among the primary services provided to international students are (1) preparing and issuing documents (Immigration form I-20 and State Department form DS-2019) to assist in securing visas before students come to the United States; (2) advising students on U.S. immigration regulations and procedures; (3) assisting with completion of paperwork to maintain legal status while enrolled at Clemson; (4) providing assistance with USCIS registration; (5) determining employment and practical training eligibility; (6) generally interpreting University policy and procedures.

IA advisors issue documents and provide advice to foreign students and exchange visitors on matters pertaining to immigration issues. The Gantt Intercultural Center works closely with members of the community organization, Clemson Area International Friendship (CAIF), to help students and exchange visitors become familiar with American customs and traditions. Students and exchange visitors needing support in how to negotiate the local environment or who simply want to make friends with American families may seek assistance from staff in the Gantt Intercultural Center.

Exchange Visitors

Internationals who attend Clemson as short-term scholars are known as "exchange visitors." The Responsible Officer (RO) for the Exchange Visitor Program issues the State Department Form DS-2019 and serves as the official contact at the University for all matters pertaining to the Exchange Visitor Program. International Affairs assists exchange visitors with issues that may involve the sponsoring department or the exchange visitor's government.

Services to the Community

The Gantt Intercultural Center provides services to the broader community by developing and participating in cultural learning opportunities and programs that engage U.S. and international students, faculty, and staff. The first week of April has been designated as International Awareness Week at Clemson University. During this week, the Gantt Intercultural Center creates a concentrated focus on world issues and generates a variety of cultural, political, and educational programs across the campus. The International Festival, now in its 15th year, is a culminating event which draws on average 5,000 visitors.

LIBRARIES

The Libraries' Web site at www.lib.clemson.edu provides access to a multitude of information resources, including the library catalog, hundreds of databases, more than 34,000 electronic journals, and information regarding library services.

The Libraries' services include circulation, reference, interlibrary loan, class instruction, and tours. Cooper Library houses a computer lab (maintained by CCIT), Java City Cyber Café, Snax & Stax convenience store, and a popular reading and audiobooks collection. Equipment available includes photocopiers, scanners, fax machines, and wireless laptops in Cooper Library and a color laser printer, engineering plotter, and large-format photocopier in the Gunnin Architecture Library.

The Clemson University Libraries consist of a main library and three branches. R. M. Cooper Library, Clemson's main library, is located at the center of campus. Most of the books and journals are located there, as well as government publications, microforms, and electronic materials. The Gunnin Architecture Library in Lee Hall contains collections that focus on architecture, city and regional planning, construction science, landscape architecture, and visual arts. Special Collections, on the lower level of the Strom Thurmond Institute, houses the rare book collection, University Archives, and many manuscript collections, including the papers of John C. Calhoun and Thomas Green Clemson. The Chemistry Reading Room in Hunter Chemistry Building contains periodical literature related to chemistry.

Total holdings for the library system include more than 1.8 million items in the form of books, periodicals, electronic resources, government publications and patents, musical recordings, DVDs and videos, audiobooks, maps, and microforms.

REDFERN HEALTH CENTER

Medical Services

Redfern Health Center, an outpatient facility, operates Monday–Friday, 8:00 A.M.–5:00 P.M. (summer hours, 8:00 A.M.–4:30 P.M.). Students are seen on an appointment basis. Students without appointments are seen in the Nurses Clinic. The student health center offers outpatient ambulatory care for illnesses and injury, pharmacy, lab, x-ray, and specialty clinics including women's health and allergy/immunization clinics.

An on-line medical clearance form, available from the Redfern Web site at staff.clemson.edu/redfern/content/immunizationpolicy.php, is required of all graduate students entering the University for the first time. Documentation of two doses of MMR (measles, mumps, and rubella) vaccines since the student's first birthday is required. Students born prior to January 1, 1957, are exempt from the measles requirements. A tuberculin skin test (PPD) is required only for students coming from countries identified by the U.S. Centers for Disease Control (CDC) as a high risk for tuberculosis. The PPD skin test must be done at Clemson. Test results from the student's home country will not be accepted. Students not in compliance with immunization requirements will not be allowed to complete registration for the next semester.

After Hours

Emergency 911 services are available after hours. Students with questions about their health care needs should call the NurseLine at 1-888-525-1333. A registered nurse is available by telephone to answer questions and offer advice about health care needs.

Students requiring the care of a physician after hours choose from area emergency rooms and urgent care facilities including Clemson Health Center (an urgent care facility), Oconee Memorial Hospital, AnMed Health Center, Palmetto Baptist Medical Center, and Greenville Memorial Medical Center. Medical costs incurred are the student's responsibility. Students should contact Redfern the next business day for follow-up care.

The University ambulance transports on-campus medical emergencies to the closest community medical resource. The University ambulance is staffed with licensed emergency medical personnel 24 hours a day. Students are required to pay for off-campus ambulance transportation.

Counseling and Psychological Services (CAPS)

Located within (and administratively a part of) Redfern Health Center, CAPS provides comprehensive mental health services from a holistic perspective. Students are seen within their context and developmental stages as psychotherapy/counseling is delivered in individual, group, or couples format. Specialized services are delivered by nutritionist, psychiatrist, and addictions counselors. All services are confidential. Students who pay the health fee are allowed up to ten individual counseling sessions per semester at no charge. Services not covered by the health fee are discussed before services are provided.

CAPS offers the convenience of accessing services Monday through Friday from 10:00 A.M.–2:30 P.M. through the walk-in clinic. Students complete paperwork and are seen for this initial brief evaluation on a first-come, first-served basis. Students who cannot meet the walk-in clinic times may call 656-2451 for appointments during the 8:00 A.M.–5:00 P.M. hours of operation.

The CU Sister/CU Brother and Lifestyles Programs assist students with substance misuse/abuse concerns. CU CARES provides counseling, advocacy,

referral, education, and support for students with concerns about sexual assault and relationship violence. Students with eating concerns/disorders are treated from a multidisciplinary approach that involves psychological, medical, and nutritional perspectives. CAPS conducts a limited number of psychological evaluations for learning disabilities and attention disorders on a first-come, first-served basis each semester.

In case of emergency, assistance and consultation are available by calling 656-2451 during regular business hours. After hours and on weekends, the on-call counselor can be reached through the University Police Department at 656-2222.

Health Promotion

The Office of Health Promotion reaches out to the entire campus community and encourages the adoption of healthy lifestyles, general positive attitudes, and the modification of risky health behaviors. In addition, the office selects and trains student peer educators to become healthy role models on campus, engages fellow students in peer counseling, gives presentations on health issues relevant to college students, and collects and disseminates information about current health topics to the whole community. The Health Promotion program covers topics such as alcohol and other drug issues, HIV/AIDS awareness and prevention, sexual health and responsibility, dating violence, healthy sleep lifestyles, nutrition, stress management, and tobacco cessation efforts, among other topics.

Health Fee

University policy requires that all students registered for seven or more credit hours on campus during the fall or spring semester or three or more on-campus credit hours during a summer session pay the University health fee. The health fee provides access to the professional services of University physicians, nurse practitioners, counselors, and health educators at no additional cost; reduced costs for medical diagnostics; and an after-hours urgent care excess insurance benefit. Students pay for pharmaceuticals, orthopedic equipment, specialty clinics, and psychological testing. Payment is expected at the time of service and may be made by cash, check, MasterCard, Visa, or Tiger Stripe.

Health Insurance—Detailed information is available at www.grad.clemson.edu/wikifinancial_info.

CLEMSON UNIVERSITY FOUNDATION

The Clemson University Foundation is a nonprofit organization that solicits, manages, and administers gifts from private sources for academic programs at Clemson University.

Chartered in 1933, the Foundation is a primary component of the Advancement Program at the University. There are 36 elected members of the Board of Directors. Currently, 34 of the 36 are Clemson alumni. The Board also includes six automatic directors; 14 ex officio directors, including a graduate and an undergraduate student representative; and 14 honorary directors.

The Foundation operates through committees that report via an Executive Committee to the full Board. These include the Finance Review, Development, Investment, Nominations, and Policy and Constitution Committees. The Audit Committee is responsible directly to the Board. Fund raising is managed by the Development Committee and, if applicable, a Campaign Executive Committee. This includes solicitation of annual, major, planned, corporate, and foundation gifts in support of University priorities and coordination of college-based fund-raising initiatives. Organizations affiliated with the Clemson University Foundation include the Clemson University Continuing Education/Conference Complex Corporation, the Clemson University Real Estate Foundation, and the Wallace F. Pate Foundation for Environmental Research and Education. As of June 30, 2007, the Clemson University Foundation managed approximately 1,300 endowments. The combined CUF-CU managed investment portfolio totaled \$375 million.

CLEMSON ALUMNI ASSOCIATION

The Clemson Alumni Association's action phrase is "Your Lifelong Connection to Clemson." Its mission is to serve, to inform, to involve. The Alumni Association works for the more than 105,000 alumni located around the world, sponsoring programs to provide a link between students of yesterday, today, and tomorrow.

In conjunction with volunteers and traveling University staff, Clemson Clubs and Clemson activities are conducted around the world. Alumni are kept informed through the award-winning *Clemson World* magazine and on the Web at alumni.clemson.edu. Students, alumni, and constituency programs, as well as publications and electronic resources, form the basis for an array of services offered to alumni, students, parents, and friends of the University.

All services of the National Alumni Association are coordinated out of the Alumni Center, a campus focal point built, furnished, and equipped entirely by gifts from alumni specifically for that purpose. The University Visitors Center, a gift of the Class of 1944, is adjacent to the Alumni Center and is an excellent stop for anyone visiting or returning to campus.

Alumni-sponsored awards programs such as Alumni Distinguished Service, Alumni Fellows, professorships, scholarships, and awards for outstanding teaching, research, and public service are among the prestigious awards given by the Clemson Alumni Association.

Alumni employees coordinate the Alumni Career Services program and the activities of the open-membership student organization, Student Alumni Association. From the Welcome Back Festival held each August to the Senior Picnic held each May, the Alumni Association provides a lifelong connection to Clemson.

ADMISSION

Information on the following topics is available at www.grad.clemson.edu/wiki/admissions_info.

Academic renewal
 Academic requirements for admission, general
 Academic requirements for admission, GMAT
 Academic requirements for admission, GRE
 Academic requirements for admission, IELTS
 Academic requirements for admission, previous academic work
 Academic requirements for admission, previous degrees
 Academic requirements for admission, professional experience
 Academic requirements for admission, standardized tests, general
 Academic requirements for admission, TOEFL
 Admission appeals
 Admission classifications
 Admission policies
 Admission policies and procedures review
 Admissions office
 Application fee, currently enrolled students
 Application fee, new students
 Application fee, non-degree seeking students
 Application fee, University employees
 Application fee, waivers
 Application, dates and deadlines
 Application, dates and deadlines, international students
 Application, degree-seeking students, international
 Application, degree-seeking students, U.S. citizens, permanent residents
 Application, forms and types
 Application, non-degree seeking students
 Application, on-line
 Application, seniors
 Application, University employees
 Applying to Clemson, Frequently Asked Questions (FAQs)
 Deferred admission
 Denied admission
 Disposition of application materials
 Electronic application
 Medical requirements for admission
 Non-degree major codes
 Non-degree students
 Postbaccalaureate students
 Readmission or re-entrance, undergraduate level
 Re-entrance, graduate level
 Re-entrance, undergraduate level
 Seniors
 Status of admission decision
 Status of application
 Teacher certification
 Transient student
 University employees
 Validity of application

FINANCIAL INFORMATION

Information on the following topics is available at www.grad.clemson.edu/wiki/financial_info. Information is also available on the University Revenue and Receivables Web site at www.clemson.edu/cfo/receivables/sar/index.html.

Council of Graduate Schools Resolution
 Deferred payments, graduate assistants
 Deferred payments, special cases
 Fees for graduate students, dining services
 Fees for graduate students, Fike Recreation
 Fees for graduate students, mandatory health insurance
 Fees for graduate students, Redfern facility use
 Fees for graduate students, University housing
 Fellowships, deadlines
 Fellowships, general information
 Fellowships, tax liability
 Fellowships, types administered by the graduate school
 Financial information, general
 Graduate assistantships, appointment process
 Graduate assistantships, eligibility
 Graduate assistantships, general
 Graduate assistantships, holiday leave (see also Graduate assistantships, leave without pay)
 Graduate assistantships, leave without pay (see also Graduate assistantships, holiday leave)
 Graduate assistantships, maternity leave
 Graduate assistantships, maximum work hours
 Graduate assistantships, minimum enrollment
 Graduate assistantships, minimum stipends
 Graduate assistantships, termination for academic deficiency
 Graduate assistantships, termination by student
 Graduate assistantships, termination for cause
 Graduate assistantships, termination for loss of research funding
 Graduate assistantships, termination financial liability
 Graduate assistantships, tuition policy
 Graduate assistantships, types
 Hourly employment
 Hours of employment, maximum
 International student employment, general
 International student employment, graduate assistantships
 International student employment, hourly off-campus
 International student employment, hourly on-campus
 Late registration service charge
 Loans
 Past due accounts
 Paw Points
 Paying by check
 Refunds, academic tuition and fees
 Refunds, dining services fees
 Refunds, housing fees
 Refunds, Tiger Stripe account
 Resident tuition and fees, appeals
 Resident tuition and fees, application for resident status
 Resident tuition and fees, entitlement
 Resident tuition and fees, statutes
 Tiger Stripe account
 Traineeships
 Tuition for graduate students (see also fees for additional expenses)

ACADEMIC REGULATIONS

Information on the following topics is available at www.grad.clemson.edu/wiki/academic_reg. Information is also available on the Registrar's Web site at www.registrar.clemson.edu/.

Academic integrity, graduate philosophy
 Academic integrity, graduate policy and procedures
 Academic policies and procedures, general information
 Academic probation, graduate assistants
 Academic probation
 Academic probation, graduate assistants and fellowship recipients
 Academic records
 Academic renewal
 Advisory committee
 Advisory committee, composition
 Auditing
 Change of major (degree program)
 Class attendance
 Combined bachelor's/master's plan
 Continuous enrollment
 Course restriction, 600-level
 Credit by examination
 Degrees conferred
 Dismissal
 Dismissal, appeal
 Doctor of Philosophy degree, candidacy
 Doctor of Philosophy degree, comprehensive examinations
 Doctor of Philosophy degree, courses
 Doctor of Philosophy degree, dissertation
 Doctor of Philosophy degree, dissertation defense
 Doctor of Philosophy degree, foreign language requirement
 Doctor of Philosophy degree, off-campus research
 Doctor of Philosophy degree, qualifying examinations
 Doctor of Philosophy degree, residence
 Doctor of Philosophy degree, time limit
 Dropping courses
 Dropping courses, appeal to denied requests
 Dropping courses, international students
 Dual master's degrees
 Duplication of higher degrees
 Enrollment limits
 Grade-point ratio
 Grading system
 Graduation requirements
 Grievances, ombudsman
 Grievances, policy and procedures
 Incompletes
 Independence of graduate degrees
 Major advisor
 Master's degree, credits required
 Master's degree, final exam
 Master's degree, foreign language requirement
 Master's degree, off-campus research
 Master's degree, residence
 Master's degree, thesis credits required
 Master's degree, thesis grades
 Master's degree, time limit
 Pass/fail enrollment
 Plan of study
 Plan of study, filing dates
 Plan of study, filing deadline and late fee
 Posthumous graduate degree
 Senior enrollment
 Specialist in education
 Syllabus
 Theses and dissertations, advisory committee approval

Theses and dissertations, advisory committee approval time line
 Theses and dissertations, electronic publishing and printing
 Theses and dissertations, Graduate School format approval
 Theses and dissertations, restrictions on publication
 Theses and dissertations, restrictions on use
 Transcripts
 Transcripts, official requests
 Transfer credit, courses
 Revalidating courses
 Withdrawing

2008-09

DEGREE PROGRAMS

Major Code	Major	Degree	Department	Department Chair
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College of Agriculture, Forestry, and Life Sciences

105	Agricultural Education	MAGEd	Agricultural and Biological Engineering	Harold Allen
114	Animal and Veterinary Sciences	MS, PhD	Animal and Veterinary Sciences	Mary Beck
122	Applied Economics*	PhD	Applied Economics and Statistics	Hoke Hill
103	Applied Economics and Statistics	MS	Applied Economics and Statistics	Hoke Hill
805	Biochemistry and Molecular Biology	MS, PhD	Genetics and Biochemistry	Albert Abbott
812	Biological Sciences	MS, PhD	Biological Sciences	Alfred Wheeler
106	Biosystems Engineering*	MS, PhD	Agricultural and Biological Engineering	Harold Allen
824	Biotechnology	MS	Genetics and Biochemistry	Albert Abbott
148	Entomology	MS, PhD	Entomology, Soils, and Plant Sciences	Joe Culin
150	Environmental Toxicology*	MS, PhD	Forestry and Natural Resources	Patricia Layton
153	Food, Nutrition, and Culinary Sciences	MS	Food Science and Human Nutrition	James Acton
156	Food Technology	PhD	Food Science and Human Nutrition	James Acton
920	Forest Resources	MFR, MS, PhD	Forestry and Natural Resources	Patricia Layton
825	Genetics	MS, PhD	Genetics and Biochemistry	Albert Abbott
865	Microbiology	MS, PhD	Biological Sciences	Alfred Wheeler
180	Packaging Science	MS	Packaging Science	Robert Kimmel
113	Plant and Environmental Sciences	MS, PhD	Biological Sciences; Horticulture; Entomology, Soils, and Plant Sciences	Halina Knap
125	Wildlife and Fisheries Biology	MS	Forestry and Natural Resources	Patricia Layton
124	Wildlife and Fisheries Biology	PhD	Forestry and Natural Resources	Patricia Layton

College of Architecture, Arts, and Humanities

205	Architecture	MArch, MS	School of Architecture	Ted Cavanagh
213	City and Regional Planning	MCRP	Planning and Landscape Architecture	Daniel Nadenicek
210	Construction Science and Management	MCSM	Construction Science and Management	Roger Liska
822	Digital Production Arts*	MFA	Digital Production Arts	Timothy Davis
620	English	MA	English	Lee Morrissey
214	Environmental Design and Planning	PhD	Planning and Landscape Architecture	Daniel Nadenicek
208	Historic Preservation	MS	Planning and Landscape Architecture	Daniel Nadenicek
635	History	MA	History	Tom Kuehn
230	Landscape Architecture	MLA	Planning and Landscape Architecture	Daniel Nadenicek
663	Professional Communication	MA	English	Lee Morrissey
212	Real Estate Development*	MRED	Planning and Landscape Architecture	Daniel Nadenicek
615	Rhetorics, Communication, and Information Design*	PhD	Art, Communication Studies, English	Victor Vitanza
240	Visual Arts	MFA	Art	Mike Vatalaro

College of Business and Behavioral Science

505	Accounting	MPAcc	Accountancy and Legal Studies	Ralph Welton
122	Applied Economics*	PhD	Economics	Raymond Sauer
605	Applied Psychology	MS	Psychology	Bruce King
607	Applied Sociology	MS	Sociology	Kinly Sturkie
509	Business Administration	MBA	Business Administration	Caron St. John
511	Economics	MA	Economics	Raymond Sauer
514	Graphic Communications	MS	Graphic Communications	Sam Ingram
639	Human Factors Psychology	PhD	Psychology	Bruce King
638	Industrial/Organizational Psychology	PhD	Psychology	Bruce King
529	Management	MS, PhD	Management	V Sridharan
539	Marketing	MS	Marketing	Gregory Pickett
212	Real Estate Development*	MRED	Finance	John Alexander

Major Code	Major	Degree	Department	Department Chair
College of Engineering and Science				
475	Automotive Engineering	MS, PhD	Mechanical Engineering	Imtiaz Haque
405	Bioengineering	MS, PhD	Bioengineering	Martine LaBerge
106	Biosystems Engineering*	MS, PhD	Agricultural and Biological Engineering	Harold Allen
415	Chemical Engineering	MS, PhD	Chemical and Biomolecular Engineering	James Goodwin
816	Chemistry	MS, PhD	Chemistry	Stephen Creager
420	Civil Engineering	MS, PhD	Civil Engineering	Nadim Aziz
423	Computer Engineering	MS, PhD	Electrical and Computer Engineering	Darren Dawson
820	Computer Science	MS, PhD	School of Computing	Robert Geist
822	Digital Production Arts*	MFA	School of Computing	Timothy Davis
425	Electrical Engineering	MEngr, MS, PhD	Electrical and Computer Engineering	Darren Dawson
440	Environmental Engineering and Science	MEngr, MS, PhD	Environmental Engineering and Earth Sciences	Alan Elzerman
441	Environmental Engineering and Science (Environmental Health Physics Concentration)	MS	Environmental Engineering and Earth Sciences	Alan Elzerman
150	Environmental Toxicology*	MS, PhD	Environmental Toxicology	Alan Elzerman
832	Hydrogeology	MS	Environmental Engineering and Earth Sciences	Alan Elzerman
445	Industrial Engineering	MS, PhD	Industrial Engineering	A. Gramopadhye
450	Materials Science and Engineering	MS, PhD	Materials Science and Engineering	Kathleen Richardson
851	Mathematical Sciences	MS, PhD	Mathematical Sciences	Robert Taylor
455	Mechanical Engineering	MS, PhD	Mechanical Engineering	Imtiaz Haque
871	Physics	MS, PhD	Physics and Astronomy	Peter Barnes
540	Polymer and Fiber Science	MS, PhD	Materials Science and Engineering	Kathleen Richardson

College of Health, Education, and Human Development

303	Administration and Supervision	MEd	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
323	Administration and Supervision	EdS	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
311	Counselor Education (Community Counseling)	MEd	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
306	Counselor Education (School Counseling)	MEd	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
312	Counselor Education (Student Affairs)	MEd	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
307	Curriculum and Instruction	PhD	Teacher Education	William Fisk
308	Early Childhood Education	MEd	Teacher Education	William Fisk
321	Educational Leadership (Higher Education)	PhD	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
322	Educational Leadership (P-12)	PhD	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
310	Elementary Education	MEd	Teacher Education	William Fisk
740	Healthcare Genetics*	PhD	Nursing	Rosanne Pruitt
327	Human Resource Development	MHRD	Leadership, Counselor Education, Human and Organizational Development	Tony Cawthon
304	Middle Grades Education	MAT	Teacher Education	William Fisk
710	Nursing	MS	Nursing	Rosanne Pruitt
960	Parks, Recreation, and Tourism Management	MPRTM, MS, PhD	Parks, Recreation, and Tourism Management	Brett Wright
324	Reading	MEd	Teacher Education	William Fisk
347	Secondary Education (English)	MEd	Teacher Education	William Fisk
350	Secondary Education (History)	MEd	Teacher Education	William Fisk
353	Secondary Education (Mathematics)	MEd	Teacher Education	William Fisk
365	Secondary Education (Natural Science)	MEd	Teacher Education	William Fisk
378	Special Education	MEd	Teacher Education	William Fisk
383	Youth Development Leadership*	MS	Health, Education, and Human Development	Larry Allen

Graduate School

822	Digital Production Arts*	MFA	Digital Production Arts	Timothy Davis
117	International Family and Community Studies*	PhD	Institute on Family and Neighborhood Life	Gary Melton
110	Policy Studies*	PhD	Strom Thurmond Institute	Bruce Ransom
670	Public Administration	MPA	Strom Thurmond Institute	Robert Smith

*Interdisciplinary program

GRADUATE SCHOOL

INTERNATIONAL FAMILY AND COMMUNITY STUDIES

Doctor of Philosophy

Certificate

The doctoral program in International Family and Community Studies educates professionals to generate, diffuse, and apply knowledge needed to strengthen communities' capacity for family support, meaningful participation, and strong relationships, including mutual assistance. The program prepares graduates as (1) scholars in interdisciplinary institutes or academic departments on child and family studies, social policy studies, international studies, or community development or (2) researchers, planners, or administrators in domestic or international governmental or non-governmental agencies concerned with children, families, and/or communities.

The program is based in the Institute on Family and Neighborhood Life and relies on the Institute's ties with related university programs in Africa, Asia, Europe, and Latin America. Students also have the opportunity to participate in the Institute's community development, policy consultation, and empirical research projects in South Carolina and other states and nations.

With its focus on family and community life, the program touches on the most fundamental aspects of people's everyday lives. Blending the humanities, the social sciences, and various professional disciplines, the program may be unique in its integration of normative analysis (i.e., philosophical, legal, and religious studies), empirical research, and community development. With a foundation in the study of human rights as applied to children and families around the world, the program builds a comparative understanding of U.S., foreign, and international law and policy on child and family issues and of the significance of democracy for the well-being of individuals, families, and communities. Students acquire an appreciation of the role of civil society (e.g., voluntary associations and nonprofit organizations) and primary community institutions (e.g., schools) in promoting and maintaining democracy. Such studies provide the foundations for an understanding of the principles and practices of community development and transformation, humanitarian assistance, and responsive human services. The important role and features of effective informal mutual assistance mechanisms in community life and their meaning for children and families are also explored.

To provide a richer understanding of human development and family life and to build skills for work in diverse cultures, international study is emphasized. Students are required to become proficient in stud-

ies of three world regions and in communication in a language other than their own. Building on the Institute's relationships with universities in developing and transitional countries, students spend at least one academic year in residence at an affiliated center outside North America, where they engage in supervised research and/or public service.

Admission Requirements

Applicants must hold a bachelor's or a master's degree from an accredited degree program. In addition to strong academic performance, experience in volunteer and/or professional public service is desirable. Students must submit GRE and/or Miller's Analogy Test scores, three letters of recommendation from professionals familiar with the applicant's academic work and/or community service, and a 500-word essay on the applicant's career aspirations and goals and their relation to this graduate program. Students for whom English is not the first language are also required to submit TOEFL scores. Both U.S. and international students are welcome, as are both new graduates and experienced professionals.

Program Requirements

The degree requires 90 credit hours of postbaccalaureate work. A minimum of 36 hours is required of postmaster's degree students. The normal course of study requires four years for postbaccalaureate students.

The program requires EDF 870, FCS 810, 811, 812, 820, 821, 822, 830, 831, 832, 833, 835, plus twelve credits selected from ANTH 603, FCS 840, PSYCH 810, 811, or SOC 805.

In addition, nine credits in area studies of three world regions and nine credits of language studies are required. (Nine of these credits may be at the undergraduate level.) Eighteen credits of dissertation research (FCS 991) are required. Students entering postbaccalaureate must also complete six hours of FCS 890.

An internship (FCS 894) of at least one academic year (two semesters) must be spent in residence at an affiliated center outside North America.

Certificate

With the approval of the Institute Director or Associate Director, domestic or international students with a bachelor's degree are admitted to the certificate program.

With advice from an Institute faculty member, students select one of four tracks and develop a plan of study based on courses selected from the following: FCS 810, 811, 812, 820, 821, 822, 830, 831, 832, 833, 835, 840, 890, 892, 893.

POLICY STUDIES

Doctor of Philosophy

Certificate

Clemson University offers graduate studies leading to a PhD degree and a Certificate in Policy Studies. Graduate work in policy studies enables a student to attain a high degree of specialized competence in policy analysis and to secure a mastery of policy research, emphasizing quantitative and economic skills. Government, industry, public policy "think tanks," and other policy research organizations, nonprofit organizations, and universities offer challenging opportunities in policy analysis, issue development, education, and related areas for persons with advanced training.

The program emphasizes quantitative, economic, and political organization as well as other social science skills in the analysis and development of policy. Fundamental and rigorous quantitative and analytical skills for effective policy analysis are developed through core courses in political economy for public policy, ethics, statistical methods for policy research, demographic projections and spatial analysis, policy analysis and political choice, organizational theory and management, applied economics, and a policy analysis workshop. PhD students also select a concentration in Agricultural Policy, Environmental and Natural Resource Policy, Rural and Economic Development Policy, or Science and Technology. Flexibility is also achieved through enrichment, electives, leadership development courses, and the selection of a PhD dissertation topic. The program consists of a minimum of 63 credit hours beyond the bachelor's degree, of which up to 24 credits may be drawn from master's degree and other postgraduate work. There is no foreign language requirement for the PhD degree in Policy Studies.

The graduate program in Policy Studies also offers students enrolled in related master's and doctoral programs the opportunity to gain competence in and understanding of policy analysis. Depending on students' backgrounds and academic preparation, they may supplement their primary master's coursework with a Certificate in Policy Studies. The Certificate in Policy Studies is designed to equip students with a set of explicit public policy research and analytical skills to augment their preparation in a traditional master's program. The certificate program involves 12 credit hours of coursework.

The faculty in Policy Studies encourages applications for the PhD program from recipients of a master's degree who wish to acquire policy research and analytical skills in economic development, agriculture, natural resource allocation, rural development, small town and community development, tourism development, environmental issues, land use, infrastructure, public finance, growth management, and science and technology. Master's-level students with similar interests are encouraged to enhance their graduate studies with a Certificate in Policy Studies.

The faculty encourages applications from students who have backgrounds that will facilitate an interdisciplinary course of study. In many cases, students may be admitted to full graduate status in the PhD program without prerequisites other than those required of all graduate students.

PUBLIC ADMINISTRATION

Master of Public Administration

The Master of Public Administration degree program requires 39–45 credit hours, depending on the student's background. Students lacking proficiency in American government are required to address the deficiency by taking a prerequisite in this area. Students who do not have substantial administrative experience are required to complete an internship encompassing 480 hours in a public or nonprofit agency engaged in administrative work. All MPA students must complete seven core courses (P ADM 702, 821, 822, 827, 829, 862, PO SC 841). In addition, one level of government course (P ADM 867, 868, or PO SC 860) and five electives must be completed. Finally, all students must demonstrate a proficient knowledge of the field of public administration by passing a comprehensive examination. Students may request to take the P ADM 880 in lieu of the comprehensive examination.

Certificate in Public Management

Admission Requirements

Admission will be based on an assessment of the applicant's educational needs and career objectives. Applicants must hold a bachelor's degree and should have earned an overall 3.0 grade-point ratio in all undergraduate studies. Each applicant must also furnish a letter of recommendation, an application (available from the MPA program office), transcripts, statement of career objectives, and a résumé.

Students from any department or discipline may elect to complete the certificate program. Students who are already enrolled in a graduate degree program must obtain written approval from their graduate programs/advisors and the MPA Director. No prerequisites are required of these students.

In addition to the conditions above, international applicants are required to demonstrate that they satisfy the University's minimum English language proficiency requirements or equivalent.

Students currently pursuing MPA coursework in a nondegree status may apply for the Graduate Certificate in Public Management. The hours earned in a non-degree status may be applied to the certificate program requirements (within four years of completion of the courses).

Course Requirements

Courses are determined by the student's educational needs and career objectives and must be reviewed and approved by the MPA director. Other graduate courses may be substituted in the elective sequence with the approval of the MPA director. Program participants must maintain an overall minimum grade-point ratio of 3.0 in the certificate program. Certificate courses must be completed within a span of four years.

A graduate certificate will be awarded upon completion of 12 credit hours of study, as outlined below, and submission of a Certificate Portfolio which will consist of a compilation of the cumulative coursework accomplished in the program.

The following coursework is required:

Core Sequence—one course selected from P ADM 821, 822, 827, 829, 862

Elective Sequence—three courses selected from P ADM 867, 868, PO SC 877, 878 (topics differ by section)

Credit earned for a certificate may be applied toward the Master of Public Administration degree with the advice and approval of the MPA Director.

COLLEGE OF AGRICULTURE, FORESTRY, AND LIFE SCIENCES

The mission of the College of Agriculture, Forestry, and Life Sciences is to provide teaching, research, and service in agriculture, forestry, and life sciences that will benefit the citizens of South Carolina and the nation. The College of Agriculture, Forestry, and Life Sciences serves more than 2,700 graduate and undergraduate students.

The ability to understand and manipulate the molecular structure of biological systems while at the same time understanding their practical management offers immense potential to improve our world, whether it is to improve foods, building products, the environment, or our health. The College of Agriculture, Forestry, and Life Sciences is using the same expertise to produce more food on a shrinking globe, grow better foods that will help prevent heart disease and fight breast cancer, package environmentally sound products, increase dairy production, increase timber production and provide new fuels, and develop businesses and promote a "green" society.

The College of Agriculture, Forestry, and Life Sciences offers 16 Masters and 13 Doctoral degree programs in disciplines in agriculture, forestry, a wide variety of biological sciences, from the fundamental to the applied. The college awards the MS and PhD degrees as well as the Master of Agricultural Education and Master of Forest Resources professional degrees. These postbaccalaureate degree programs are designed primarily to provide continuing education for individuals whose interests lie outside a research-oriented profession.

The program in Applied Economics is a cooperative effort between the Department of Applied Economics and Statistics and the Department of Economics in the College of Business and Behavioral Science. The programs in Biosystems Engineering and Environmental Toxicology are jointly administered with the College of Engineering and Science. Cooperative programs with state, federal, and private agencies allow students to extend their research off campus to the Greenwood Genetics Center, research and education centers spanning South Carolina, and state and national forests of the Savannah River Basin. Proximity to the Blue Ridge Mountains provides access to one of the most biologically diverse regions of the world.

AGRICULTURAL EDUCATION

Master of Agricultural Education

The Master of Agricultural Education is a professional degree designed to enhance the human resource skills in agriculture and education. The flexible program provides a core of planning, delivery, evaluation, and administrative strategies while encouraging specialization in teacher education, adult and extension education, agricultural communications, youth development, or technology transfer. Graduates hold positions as agriculture teachers, extension agents, agricultural and environmental agency employees, as well as human resource development specialists in the agricultural industry.

Candidates for the degree are required to plan a program of study in consultation with the major advisor and graduate committee and complete a minimum of three credit hours in adult education, three hours in research methods, and three hours in statistics; a minimum of 12 credit hours in the major field; and a minimum of six credit hours in an area of concentration outside the major field.

A minimum of 30 credit hours is required for the professional degree. At least one-half of these credit hours must be selected from courses numbered 700 or above. The student's program of study must be approved by the advisory committee.

Admission Requirements

Students must complete all University applications, submit undergraduate overall grade averages and GRE scores, participate in an interview with a department graduate committee, and submit a writing sample on a topic assigned by the interview committee. Desirable scores include an undergraduate overall grade-point ratio near 3.0 and GRE scores of 450/450/3.0. Acceptance will be based on an evaluation involving all of the above as well as appropriate recommendations. Provisional acceptance may be awarded and additional undergraduate coursework may be required for marginally qualified students, students without undergraduate Agricultural Education degrees, and those seeking teacher certification.

ANIMAL AND VETERINARY SCIENCES

Master of Science

Doctor of Philosophy

Applicants to the Animal and Veterinary Sciences programs should have a strong background in the animal, biological, and physical sciences. Students with deficiencies in these sciences may be admitted provided they correct these deficiencies during the first year of the program of study.

MS students are required to complete coursework in an area of interest approved by the graduate advisory committee. The student's academic program and research emphasize a study of physiological processes, particularly those relating to reproduction, endocrinology, immunology, digestion, and environmental factors. A thesis is required.

The PhD degree program does not have formal coursework requirements, but it is recognized that students will have individual deficiencies; therefore, it is the responsibility of the student and major advisor, in consultation with the graduate advisory committee, to prescribe coursework to correct these deficiencies. A dissertation is required.

All students in Animal and Veterinary Sciences are required to complete AVS 820.

The following courses offered by various departments represent possible electives for students in Animal and Veterinary Sciences: AVS 653, 655, 803, 825, BIOCH 606, 623, 633, 634, 815, BIOSC 632, 633, 659, 660, 661, 668, 670, 671, 672, 675, 676, 677, (AVS) 680, ENT (BIOSC) 636, EX ST 801, 803, 805, MICRO (AVS, BIOSC) 614, 811.

APPLIED ECONOMICS

Doctor of Philosophy

The graduate program in Applied Economics utilizes the facilities and faculty of the Department of Applied Economics and Statistics and those of the Department of Economics in the College of Business and Behavioral Science. Students may carry out their dissertation research under the direction of a faculty member from either department.

Applicants to the PhD program should have a strong background in economic theory and statistics. Core requirements of the program include microeconomics, macroeconomics, and an econometrics course sequence. Students choose two additional concentrations from agribusiness, applied statistics, community and economic development, environmental economics, financial economics, industrial organization, labor economics, monetary economics, and public sector economics.

APPLIED ECONOMICS AND STATISTICS

Master of Science

Graduate work in Applied Economics and Statistics enables students to add to their understanding of principles of economics, econometric methods, environmental statistics, and statistical techniques. Instructional focus is on applied problem solving and relevant case studies and projects. Special emphasis is placed on the economics of agricultural production and marketing, issues in agribusiness, economic development, and analysis of government programs and policies. Similar emphasis is given to the use of statistical techniques in research design, survey design, and data analysis as well as for solution of business, management, and institutional problems. Additional emphasis is in the natural resource arena, where environmental techniques, ecological statistics, and economic analysis of issues and policies are presented and discussed.

Both thesis and nonthesis options are available. The curriculum for both options includes recommended courses in applied economics and experimental statistics. Flexibility is achieved through choice of elective courses and, for the thesis option, in the selection of a master's thesis topic. There is no foreign language requirement.

The department encourages applications from students with baccalaureate degrees in Agricultural or Applied Economics, Economics, Statistics, Mathematics, in natural resource areas such as Forestry or Wildlife Biology, and other majors. Additional information is available at cherokee.agecon.clemson.edu/.

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Master of Science

Doctor of Philosophy

Enrollment in the Biochemistry and Molecular Biology program is open to students with baccalaureate degrees in agricultural, biological, or physical sciences or engineering. Entering students must have satisfactory academic records in mathematical, physical, and biological sciences. Research activities include bioinformatics, functional genomics, microbial and plant biochemistry, molecular biology, proteins, and signal transduction.

Degree Requirements

Both MS and PhD programs require 24 credit hours including the following core courses: BIOCH (GEN) 805, BIOCH (GEN) 810, BIOCH 814, GEN 814.

Students, with the guidance of the advisory committee, will select elective courses (nine hours for both the MS and PhD degrees) from the following: BIOCH 631, 632, 636, 643, 816, 818, 821, 822, 828, 832, 890, GEN 610, 620, (BIOCH) 640, 650, 670, 801, 803, 815, (BIOCH) 820, 830, 890.

MS candidates will present seminars (BIOCH (GEN) 851) twice, and PhD candidates will present seminars (BIOCH (GEN) 851) three times. All graduate students are required to attend GEN (BIOCH) 825 or deliver seminars (BIOCH (GEN) 851) every semester they are enrolled.

A minimum of six credit hours of research, culminating in a thesis, is required of master's candidates.

A dissertation, consisting of 18 credits of doctoral research (BIOCH 991) exclusive of any research credits earned at the master's level, is required of PhD students. Successful completion of written and oral comprehensive examinations will admit doctoral students to candidacy for the PhD degree.

BIOLOGICAL SCIENCES

Master of Science

Doctor of Philosophy

The MS and PhD degree programs in Biological Sciences encompass a wide variety of disciplines in both plant and animal biology with three major emphasis areas: Ecology and Evolutionary Biology, Cell and Developmental Biology, and Comparative Organismal Biology.

Applicants to the graduate degree programs in Biological Sciences must have a bachelor's or master's degree and a background of training in biology. All students are expected to have completed inorganic and organic chemistry, physics, calculus, introductory biology, plant and animal diversity, genetics, cell or developmental biology, physiology, and

ecology. Deficiencies (less than 18 hours total) may be remedied through appropriate coursework completed during the graduate program. Graduate credit is not normally awarded for remedial coursework. Students with more than 18 hours of deficiencies including those with degrees outside of biology are encouraged to contact the Department of Biological Sciences to discuss options for fulfilling coursework requirements in preparation for application to the MS and PhD programs.

Candidates for the MS degree must complete 30 hours of graduate credit, including 24 credits of coursework, six credits of thesis research, an acceptable thesis based on original research, and satisfactory performance in a final oral examination.

Candidates for the PhD degree must complete written and oral comprehensive examinations, 18 credits of dissertation research, an acceptable dissertation based on original research, and satisfactory performance in a final oral examination. Although there is no required coursework for the doctorate beyond the 18 credits of dissertation research, some graduate coursework emphasizing breadth and depth of knowledge in the life sciences is expected of each candidate.

BIOSYSTEMS ENGINEERING

Master of Science

Doctor of Philosophy

This program is administered jointly with the College of Engineering and Science. See page 36 for program details.

BIOTECHNOLOGY

Master of Science

The MS degree in Biotechnology is administered by the Department of Genetics and Biochemistry. This nonthesis degree (usually used as part of a five-year Combined Bachelor's/Master's Program) prepares students for research associate positions in the growing biotechnology and pharmaceutical industries. Students acquire a solid foundation in biotechnology theory plus knowledge of industry-oriented Good Laboratory Practices and Good Manufacturing Practices. The degree has options in Molecular Biology and in Bioprocessing.

Admission Requirements

Entering students must have a Bachelor of Science degree in a life science, agricultural, chemistry, or bioengineering field. Students entering the BS/MS program must have completed their junior year (minimum 89 credit hours) in one of these majors with a minimum grade-point ratio of 3.40. Students must have taken basic undergraduate courses in biochemistry, genetics, and microbiology. A mathematics course on modeling with differential equations is recommended for the Molecular Biology Option but required for the Bioprocessing Option. Students will be given conditional admission to the master's program pending completion of their bachelor's degree and submission of satisfactory GRE scores.

Degree Requirements

Both options require thirty credit hours, including the following core courses: B E 835, BIOCH 633, BIOCH (GEN) 805, BIOCH (GEN) 810, BIOCH (GEN) 851 (or an equivalent seminar course in the student's major), EX ST 801, GEN (BIOCH) 825. In addition, students in the Molecular Biology Option must take three credits of GEN 491 (or an equivalent research course in the student's major), GEN 640, and GEN (BIOCH) 820. Students in the Bioprocessing Option must take B E (CH E) 628, B E 638, 901 (or an equivalent research course in the student's major), and MICRO 613.

Once these requirements are met, students, in consultation with the advisor, choose from the following courses to complete the thirty credit hours required in the program: B E (CH E) 628, B E 635, 638, 838, BIO E 849, BIOCH 631, 632, 634, 643, 814, 816, 818, 821, 822, 832, 890, CH E 601, 804, CH E (EE&S) 814, EX ST 805, GEN (BIOCH) 640, 814, 890, GEN 820, MICRO 613.

ENTOMOLOGY

Master of Science

Doctor of Philosophy

The Entomology graduate programs of the Department of Entomology, Soils, and Plant Sciences are dedicated to providing leadership in environmental entomology. Research programs fall into four emphasis areas: arthropod biodiversity, agricultural entomology, genetics and biotechnology, and urban entomology. Facilities of the South Carolina Experiment Station on campus and at four research and education centers located in various regions of the state are available for graduate student research. In addition to teaching and research laboratories, specialized facilities within the department include the Clemson University Arthropod Collection; laboratories for molecular genetics, tissue culture, and analytical chemistry/toxicology; wet laboratories; controlled and ambient temperature insect-rearing facilities; a free-flight butterfly facility; and greenhouses. Candidates for the MS degree must complete 30 hours of graduate credit, including six hours of research, and write a thesis. Candidates for the PhD degree must complete 18 hours of dissertation research and write a dissertation.

ENVIRONMENTAL TOXICOLOGY

Master of Science

Doctor of Philosophy

Environmental toxicology is the scientific study of chemical, physical, and biological stimuli in environments and the effects of these stimuli on living systems and their external and internal physical, chemical, and biological integrity. Emphases include the metabolism of contaminants, their decomposition, fate, and effects in aquatic and terrestrial environments. This interdisciplinary program provides a strong background in fundamental environmental toxicology and ecotoxicology. The program is administered jointly with the College of Engineering and Science.

Students with baccalaureate degrees in the basic and life sciences, agriculture, or engineering may be admitted. Strong faculty expertise and areas of student specialization are available in wildlife toxicology, environmental chemistry, biochemical and mechanistic toxicology, ecological modeling, ecological risk assessment, and biological control. Each student's research program is designed to meet his/her professional goals.

Candidates for the MS degree must complete 30 hours of graduate credit, including six hours of research, and write a thesis. Candidates for the PhD degree must complete 18 hours of dissertation research and write a dissertation.

Graduate research programs are conducted in conjunction with the Clemson Institute of Environmental Toxicology, providing a unique and innovative environment for graduate education. Collaborative research opportunities exist nationally and internationally with other universities, state and federal agencies, and industrial groups.

FOOD, NUTRITION, AND CULINARY SCIENCES

Master of Science

Detailed information is available from the Department of Food Science and Human Nutrition or at www.clemson.edu/foodscience/.

Admission Requirements

Students admitted to the MS program in Food, Nutrition, and Culinary Sciences must meet the following criteria. Students not meeting the minimum requirements may be admitted in a provisional status with the approval of the graduate faculty.

1. The Aptitude Test of the Graduate Record Examination (GRE General Test) must be taken by all applicants. A minimum total GRE score of 1000 on the two-component exam is required. In some cases, other tests administered for students applying for postbaccalaureate degrees may be accepted in lieu of the GRE (e.g., MCAT).

2. A strong background in food science; human nutrition; physical, chemical, or biological sciences; or engineering is highly desirable.

3. Proficiency in food science must be demonstrated by satisfactory completion of coursework in the following areas: food chemistry, food microbiology, food processing, and biochemistry. Background course requirements will normally be satisfied with completion of a BS degree in Food Science from an accredited institution. Students deficient in any of these areas will be required to complete coursework to fulfill these background course requirements.

4. Acceptance is based upon academic transcripts with a minimum undergraduate grade-point ratio of 3.0, three letters of recommendation, a statement of objectives and professional experience.

5. International students must have a minimum Test of English as a Foreign Language (TOEFL) score of 575 and must also submit documentation of adequate financial support for their studies.

6. An additional requirement for admission is identification of a research advisor prepared to accept the applicant as an advisee.

Financial Aid

A limited number of research assistantships are available from grant funds, with the student assisting in the research supported under the grant. This research often may be applicable to the thesis or dissertation. Interested applicants should contact individual faculty for research assistantships. Applicants whose files are completed prior to February 15, 2009, will be given preferential consideration for research assistantships offered beginning fall semester 2009.

Transfer of Credits

With preapproval, up to eight graduate credits may be transferred into the MS program. A grade of B or better is required in each course transferred.

Course Requirements

A minimum of 24 credit hours of coursework and six credit hours of thesis research (FD SC 891) is required for the MS degree. Only 600-level courses and higher may be used for graduate credit, and at least one-half of the 24 hours of coursework must be at the 800 level or higher.

The following courses are required: EX ST 801 or equivalent, FD SC 851 (one-credit hour seminar each year), 18 credit hours of advanced-level courses (may include courses in food science or in areas such as chemistry, nutrition, biochemistry, animal and veterinary sciences, microbiology, statistics, or cell biology, as required by the student's Graduate Advisory Committee), and six credit hours of thesis research (FD SC 891).

In addition, a minimum grade-point ratio of 3.0 is required to maintain good academic standing and for graduation.

Combined BS in Food Science/MS in Food, Nutrition, and Culinary Sciences

Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. Enrollment guidelines and procedures can be found in the *Undergraduate Announcements*. Consult the Department of Food Science and Human Nutrition for details.

FOOD TECHNOLOGY

Doctor of Philosophy

Students admitted to the PhD program in Food Technology must meet the following criteria. Students not meeting the minimum requirements may be admitted in a provisional status with the approval of the graduate faculty.

1. The Aptitude Test of the Graduate Record Examination (GRE General Test) must be taken by all applicants. A minimum total GRE score of 1000 on the two-component exam is required. In some cases, other tests administered for students applying for postbaccalaureate degrees may be accepted in lieu of the GRE (e.g., MCAT).

2. A strong background in food science; human nutrition; physical, chemical, or biological sciences; or engineering is highly desirable.

3. Proficiency in food science must be demonstrated by satisfactory completion of coursework in the following areas: food chemistry, food microbiology, food processing, and biochemistry. Background course requirements will normally be satisfied with completion of a BS degree in Food Science from an accredited institution. Students deficient in any of these areas will be required to complete coursework to fulfill these background course requirements.

4. Acceptance is based upon academic transcripts with a minimum undergraduate grade-point ratio of 3.0, three letters of recommendation, a statement of objectives and professional experience.

5. International students must have a minimum Test of English as a Foreign Language (TOEFL) score of 575 and must also submit documentation of adequate financial support for their studies.

6. An additional requirement for admission is identification of a research advisor prepared to accept the applicant as an advisee.

Financial Aid

A limited number of research assistantships are available from grant funds, with the student assisting in the research supported under the grant. This research often may be applicable to the thesis or dissertation. Interested applicants should contact individual faculty for research assistantships. Applicants whose files are completed prior to February 15, 2009, will be given preferential consideration for research assistantships offered beginning fall semester 2009.

There are no set course requirements for the doctorate in Food Technology. It is expected that each PhD graduate will have a comprehensive understanding of the principles of food science with an expanded knowledge covering their focused research area. The PhD candidate's research committee will have final approval on all coursework. PhD candidates must pass both written and oral examinations given by the student's advisory committee. The successful student must also write and defend a dissertation to the satisfaction of the advisory committee. Dissertations usually contain a review of the literature and a detailed description of research in a scientific publication format. PhD students should expect to publish a minimum of two refereed research manuscripts from their dissertations.

FOREST RESOURCES

Master of Forest Resources

Master of Science

Doctor of Philosophy

Enrollment in the Master of Forest Resources and Master of Science programs is open to students who have earned a baccalaureate degree in forestry, forest products, or a related field. A master's degree, preferably in a forestry discipline, is required for enrollment in the Doctor of Philosophy program. The candidate may be required to satisfy undergraduate deficiencies before being admitted to full status.

The Master of Forest Resources, a nonthesis degree, requires a minimum of 36 credit hours of graduate coursework with at least 18 of the required hours selected from courses numbered 700 or above.

A formal thesis is required for the MS and PhD degrees. The MS degree requires a minimum of 24 credit hours of coursework and six hours of research. The PhD degree requires a minimum of 16 credit hours of coursework and 18 hours of research. For both degrees, one-half of the semester hours must be selected from courses numbered 800 and above.

GENETICS

Master of Science

Doctor of Philosophy

The MS and PhD degrees in Genetics are administered by the Department of Genetics and Biochemistry. Research activities include biochemical, biometrical, molecular, and population genetics, as well as bioinformatics, cytogenetics, and structural and functional genomics through arrangements with other participating disciplines and with the Greenwood Genetics Center.

Degree Requirements

Both MS and PhD programs require 24 credit hours including the following core courses: BIOCH (GEN) 805, BIOCH (GEN) 810, BIOCH 814, GEN 814.

Students, with the guidance of the advisory committee, will select elective courses (nine hours for both the MS and PhD degrees) from the following: BIOCH 631, 632, 636, 643, 816, 818, 821, 822, 828, 832, 890, GEN 610, 620, (BIOCH) 640, 650, 670, 801, 803, 815, (BIOCH) 820, 830, 890.

MS candidates will present seminars (BIOCH (GEN) 851) twice, and PhD candidates will present seminars (BIOCH (GEN) 851) three times. All graduate students are required to attend GEN (BIOCH) 825 or deliver seminars (BIOCH (GEN) 851) every semester they are enrolled.

A minimum of six credit hours of research, culminating in a thesis, is required of master's candidates.

A dissertation, consisting of 18 credits of doctoral research (GEN 991) exclusive of any research credits earned at the master's level, is required of PhD students. Successful completion of written and oral comprehensive examinations will admit the doctoral students to candidacy for the PhD degree.

MICROBIOLOGY

Master of Science

Doctor of Philosophy

The Department of Biological Sciences administers the MS and PhD degree programs in Microbiology. The Microbiology graduate programs includes a wide variety of disciplines with three major emphasis areas: Cellular and Physiological Microbiology, Microbial Genetics and Molecular Microbiology, and Environmental Microbiology.

Applicants to the graduate degree programs in Microbiology must have a bachelor's or master's degree and a background of training in biology (botany, microbiology, or zoology), chemistry, or

in one of the agricultural sciences. Undergraduate work in bacteriology or microbiology is desirable but not necessary. All students are expected to have completed inorganic and organic chemistry, physics, calculus, general biology, and genetics. Deficiencies (less than 18 hours total) may be remedied through appropriate coursework completed during the graduate program. Graduate credit is not normally awarded for remedial coursework. Students with more than 18 hours of deficiencies including those with degrees outside of biology, chemistry, or agricultural sciences are encouraged to contact the Department of Biological Sciences to discuss options for fulfilling coursework requirements in preparation for application to the MS and PhD programs.

Candidates for the MS degree must complete 30 hours of graduate credit, including 24 credits of coursework, six credits of thesis research, an acceptable thesis based on original research, and satisfactory performance in a final oral examination. The 30 credits of graduate coursework will include courses from each of the following areas: cellular and physiological microbiology, microbial genetics and molecular microbiology, and environmental microbiology.

Candidates for the PhD program must complete written and oral comprehensive examinations, 18 credits of dissertation research, an acceptable dissertation based on original research, and satisfactory performance in a final oral examination. Although there is no required number of credits of coursework for the doctorate beyond the 18 credits of dissertation research, a core of graduate coursework including courses from each of the following areas is expected of each candidate: cellular and physiological microbiology, microbial genetics and molecular microbiology, and environmental microbiology.

PACKAGING SCIENCE

Master of Science

The MS degree program in Packaging Science prepares graduates to work independently in the research, development, and application of new packaging materials and processes. Students may be accepted with backgrounds relating to chemistry, physics, mathematics, biology, or engineering. Students with backgrounds in business or graphic communications or other disciplines may also be accepted after completing courses equivalent to the basic science and mathematics courses in the department's undergraduate curriculum. Each degree program is designed individually to augment the student's background to provide a broad understanding of packaging science and specialized knowledge in the area of the student's research.

The MS degree in Packaging Science requires 30 hours of coursework, six of which are thesis research, and the completion of an acceptable MS thesis. In addition to PKGSC 891, students register for at least one credit of PKGSC 851.

The following courses represent possible electives for the student in Packaging Science: C M E 815, CH E 612, 804, EX ST 801, 802, FD SC 601, 602, 604, 606, 608, 810, 811, 812, G C 606, 607, 648, MKT 627, 630.

PLANT AND ENVIRONMENTAL SCIENCES

Master of Science

Doctor of Philosophy

The degree programs in Plant and Environmental Sciences are offered through an interdepartmental program comprised of faculty from disciplines including biological sciences, botany, crop science, entomology, genetics, horticulture, plant pathology, plant physiology, and soil science.

Candidates for the program in Plant and Environmental Sciences should have a strong undergraduate background in the biological, agricultural, and/or physical sciences as appropriate to their focus areas. Undergraduate curricula that may provide this background are botany, biology, chemistry, or one of the agricultural plant and soil environmental sciences such as agronomy, forest resources, or horticulture. Students with nontraditional backgrounds may need to complete some relevant undergraduate courses to supplement the graduate program.

Each student's degree program is tailored to his/her professional goals and is guided by an advisor and graduate committee with expertise appropriate to the student's area of specialization. All graduate students must select an advisor before admission.

Candidates for the MS degree must complete 24 credit hours of coursework and six hours of research, and they must present and defend a thesis based on original research. MS students who plan nonresearch-related careers in public gardening, landscape design, extension, consulting, or agribusiness may complete 30 credit hours of coursework and undertake a professional development/public service project option in lieu of thesis-related research. Interdisciplinary studies in plant health and integrated pest management are also available under this option.

A dissertation based on original research is required for the PhD degree. There is no specific credit hour requirement; the plan of coursework is based on the student's interests and dissertation emphasis, as determined in consultation with the major advisor and graduate committee.

Individual plans of study include courses from the following areas: biochemistry, biological sciences, botany, crop and soil environmental science, entomology, genetics, horticulture, and plant pathology as well as plant and environmental sciences.

WILDLIFE AND FISHERIES BIOLOGY

Master of Science

Doctor of Philosophy

Those who are interested in pursuing a graduate degree in Wildlife and Fisheries Biology should have sound undergraduate training in the biological or related sciences. Initially, applicants should contact the faculty members whose research interests are closest to their own. Programs of study are designed to emphasize relationships between wild animals and their changing environments and production of aquatic organisms.

Admission to either the master's program or the doctoral program requires acceptance by the University and the Graduate Student Admission Committee of Wildlife and Fisheries Biology. This committee will base its acceptance recommendation to the Graduate Admissions Office on previous coursework, GRE scores, letters of recommendation, undergraduate background, and current research interests. Students are required to have completed a bachelor's degree, preferably in a natural science, with a minimum of 30 credit hours in natural sciences. In addition, an MS in Natural Resource Biology or related area usually is preferred, but not required, for acceptance into the doctoral program. Students accepted without the appropriate course background will be required to make up these deficiencies as outlined by the Graduate Student Admission Committee and consistent with University admission policies.

The MS degree program requires 24 credit hours of coursework, six hours of research credits (WFB 891), an acceptable thesis based on original research, and satisfactory performance on a final oral examination. Additional coursework usually includes subjects such as experimental statistics, biological sciences, and forestry. Thesis research areas include aquaculture, conservation biology, upland and wetland wildlife biology, endangered species biology, freshwater fisheries science, and marine fisheries science.

The PhD degree program has no specific credit-hour requirements beyond 30 hours of postbaccalaureate coursework and 19 hours of doctoral dissertation research; however, the student's advisory committee will insist on a rigorous and appropriate program of study and research. Students are required to take, or have taken, at least two semesters of graduate statistics and two semesters of 800-level seminars in fisheries and wildlife science or related areas. Students must also have at least one semester of professional experience, which will be evaluated by the advisory committee. Examples of appropriate professional experience are teaching assistantships, internships or cooperative study program participation, or natural resource agency employment. Other course requirements will be identified by the student's advisory committee and will include specific courses according to the elected emphasis area: fisheries biology, wildlife biology, or conservation biology.

Research opportunities are enhanced by cooperative programs with the S.C. Department of Natural Resources, U.S. Geological Survey Cooperative Research Unit at Clemson, Savannah River Ecology Laboratory, Webb Wildlife Research Center, and Waddell Mariculture Center. The department also is associated with the National Council for Air and Stream Improvement Eastern Wildlife Program. The graduate program is accredited by the Southeastern Section of the Wildlife Society.

Combined BS/MS in Wildlife and Fisheries Biology

Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. Students should obtain specific requirements for the dual degree from the Department of Forestry and Natural Resources as early as possible in their undergraduate program to ensure that all prerequisites are met. Enrollment guidelines and procedures can be found in the *Undergraduate Announcements*.

COLLEGE OF ARCHITECTURE, ARTS, AND HUMANITIES

The College of Architecture, Arts, and Humanities offers graduate programs in three schools: the School of Design and Building, the School of the Arts, and the School of Humanities. Advanced degrees are offered in Architecture; City and Regional Planning; Construction Science and Management; Digital Production Arts; English; Environmental Design and Planning; Historic Preservation; History; Landscape Architecture; Professional Communication; Real Estate Development; Rhetorics, Communication, and Information Design; and Visual Arts.

Courses are offered in art and architectural history, communication studies, geography, languages, literature, performing arts, philosophy, religion, and women's studies to provide electives for students in other areas.

Graduate students in the School of Design and Building and the School of the Arts have the opportunity to study at the Charles E. Daniel Center for Building Research and Urban Studies in Genoa, Italy, which is sponsored jointly by the College and the Clemson Advancement Foundation for Design and Building. Emphasis is placed on studies related to this historic port city and the art and architectural heritage of the Italian setting. Studio and classroom work are enriched by visiting scholars and critics and complemented by scheduled field trips, both in Italy and continental Europe.

Courses of study in the Daniel Center, while under the jurisdiction of the related departments of the College of Architecture, Arts, and Humanities, are administered and taught by the professors-in-residence. Studio work is the core of the Genoa program, whether in architecture, construction science and management, or visual arts. All students undertake a history research project, conduct field studies, and participate in a design seminar.

The School of Humanities houses programs leading to the Master of Arts in English, History, and Professional Communication and the Doctor of Philosophy in Rhetorics, Communication, and Information Design. The school also offers certificate programs in Health Communication and Writing Assessment. Faculty have been recipients of grants from agencies and foundations, such as the National Endowment for the Arts, the National Endowment for the Humanities, the John Simon Guggenheim Memorial Foundation, and the Bingham Trust. They have also held Fulbright Senior Lectureships and Research Awards in many countries.

ARCHITECTURE

Master of Architecture

Master of Science

The Master of Architecture is a professional degree program that develops proficiency in responding to contemporary architectural issues through a range of both practical and theoretical knowledge, while providing opportunities for creatively challenging the limits of the profession. Major emphasis is on design, accompanied by complementary coursework of a professional focus, as well as elective subjects. Complex studio design projects stress social awareness and contextual fit and are responsive to all aspects of the architectural process. Practical experience is a requisite part of the overall program, which is concluded with a thesis or project combining literary research with design synthesis.

Admission to the MArch program is based on the student's ability to respond effectively to the intellectual rigor and creative challenge integral to graduate architecture study. This potential is measured by demonstrated proficiency in prior academic work and Graduate Record Examination (GRE) general test scores, as well as creativeness of mind, motivation of spirit, and maturity of purpose. A postbaccalaureate program of preparatory study is available to qualified applicants with backgrounds in areas other than design. Detailed information is available from the School of Architecture.

The Master of Architecture degree requires a minimum of two academic years. Degree candidates may elect a concentration of study in architecture or architecture and health care. Each student's specific plan of study is determined in consultation with the major advisor and is intended to reflect individual educational objectives and career goals, while assuring a comprehensive development of professional competence. The graduate faculty reviews each student each semester of the first year to determine if his/her performance is acceptable to continue in the program. A standing committee of the graduate faculty will evaluate the oral defense. Requirements for the MArch degree include 60 credit hours of approved coursework with a minimum grade-point ratio of 3.0. Students in the final year have the option of enrolling in the thesis project by taking ARCH 858 (Thesis Research), ARCH 859 (Thesis Manuscript), and ARCH 891 (Thesis Project). Students in the nonthesis option will enroll in elective courses as well as ARCH 892 (Comprehensive Studio).

Students in the Architecture program should be aware that ARCH 859 (Thesis Manuscript) is a graded course and may be taken only once. If a student's final thesis or project is not complete by the end of the semester in which he/she enrolls in ARCH 859, the student should take an *incomplete* in ARCH 859 and enroll in G S 799 while finishing the thesis or project. After the thesis or project is completed, the *incomplete* in ARCH 859 can be converted to a final grade.

Architecture Concentration

This inclusive course of study leading to the MArch degree allows the student to pursue individual academic and career objectives within the context of a rigorous professionally directed architecture program. The focus of learning is the design studio, where the student is involved in a range of theoretical and real-world explorations. Advanced studies in technology, theory, and professional practice complement design work and are accompanied by additional subjects determined in concert with the major advisor.

Although designated subjects in design and other professional studies constitute a major portion of work in this concentration, sufficient elective hours are available to establish a study plan responsive to individual interests. The choice of thesis provides a further opportunity for personal development.

Architecture + Health Concentration

Within the framework of the Master of Architecture degree, the Architecture + Health Concentration includes seminar courses and studio work appropriate for both a general professional degree and a concentration in Architecture + Health. The intent is to develop the generalist-specialist—graduates who can creatively work in both modes. This concentration includes both the study of health facility design and the study of relationships between architectural settings and their impact on human health and well-being. The primary purpose of the concentration is to study how architectural environments impact health and how to create architectural settings that support health and well-being of individuals and larger populations.

Studio design projects and courses examine these relationships for architectural settings and conditions ranging from entire communities and health care systems to specific projects and individual interior or exterior spaces. The studio emphasizes design excellence within the framework of rigorous and complex demands found in the practice of health care architecture. Student work is expected to stand up critically at all levels of architectural consideration.

The Architecture + Health Concentration is demanding in the scope of its professional studies, with most of the coursework designated for specific areas of learning. Students may take advantage of the same off-campus programs available to students in the Architecture Concentration during their first semester of study. Given the number of required courses, students may opt for a five-semester plan of study beginning in the spring semester. The thesis or project, developed during the final year, normally deals with particular architectural topics as they relate to health and/or health facility design.

Master of Science Program

The Master of Science degree in Architecture is a postprofessional degree program which offers the opportunity to achieve advanced learning within the discipline of architecture and to undertake research responsive to increasingly complex challenges attendant to the built environment. This is accomplished through a foundation of coursework, accompanied by directed studies within a selected area, and followed by the critical examination of a singular aspect of architecture in a research thesis.

Admission to the MS program is available to students who have a first professional degree in architecture and who possess the intellectual mettle and dedication necessary to respond successfully to the rigor of advanced study and independent research. This is measured by academic proficiency in prior work, a well-reasoned plan of advanced study, and GRE general test scores. Information concerning application procedures and requirements is available from the School of Architecture.

The coursework and directed studies required of the Master of Science program may be completed in one academic year, after which a variable period of time is dedicated to the research thesis. Degree candidates work within one of the following areas: architecture and health care facilities, environmental issues in architecture, architecture and human perception, or theory and philosophy of architecture. A plan of study is determined in consultation with the major advisor who, along with the advisory committee, periodically reviews the student's work and evaluates the research thesis. Requirements for the MS degree consist of 24 credit hours of combined coursework and directed studies with a minimum grade-point ratio of 3.0 and the acceptance of a six-hour research thesis.

CITY AND REGIONAL PLANNING

Master of City and Regional Planning

The two-year Master of City and Regional Planning program is a professional degree emphasizing applied study in preparing tomorrow's leaders for planning and developing the nation's towns, cities, and regions. The curriculum emphasizes applied study preparing for the challenge of planning vibrant and sustainable communities. Graduates are well-equipped for careers in private sector planning and development, as well as public sector planning and administration. The nationally accredited program began in 1968 and has more than 400 graduates.

The program emphasizes sustainable land development, applying appropriate technology and recognizing the balance of physical, economic, financial, social, and policy dimensions of planning. The program has a professional application focus mainly concerned with providing a solid planning education to qualified students, primarily to meet the needs of South Carolina, the southeastern region, and the nation. The generalist approach is employed with the flexibility for specialization in four areas: development planning, transportation, environmental land use planning, and geographic information systems. A substantive core emphasizes the general framework, theories, methods, and applications of the planning process. Strong ties with the professional community reinforce the professional application focus.

Students come from a variety of undergraduate majors and professional backgrounds—primarily liberal arts, the social sciences, environmental science, business, management, and design—and from many states and several countries. The MCRP program typically has annual classes of approximately 15–20

students, providing the opportunity for extensive faculty involvement in teaching, research, and public service.

While the curriculum covers theory and policy issues, the principal focus emphasizes the applied skills students need to enter the job market as professional planners and to evolve as leaders in the field. Classes use real-world situations for analysis and for the application of planning skills in dealing with land use planning, development, and issues of the built and natural environment.

Planning students are equipped to meet opportunities facing communities in many creative ways. Many first-year students work two days per week as department assistants for professors or in planning related entities. Students typically work full time as interns in planning or development organizations during the summer between their first and second academic years. During their second year, most students work two days a week with a public, private, or nonprofit entity as student public service assistants (SPSA). This allows them to gain additional professional experience. Students also interact in interdisciplinary teams.

Department assistants generally earn around \$2,500 for nine months at 10 hours per week; SPSAs earn around \$4,000 at 15 hours per week and usually require an automobile for transportation to positions throughout the area. Both assistantships provide significant tuition reduction. Students also have the opportunity to participate with the Center for Community Growth and Change and the Center for Real Estate Development.

Students are actively involved in Clemson's Planning Student Organization of the American Planning Association (APA) and SCAPA. The program director and student president of the Clemson student chapter are both on the SCAPA Executive Committee.

Clemson's graduates have been successful in the public, private, and nonprofit sectors, attaining key positions in traditional planning agencies, development groups, nonprofit organizations, and private consulting firms. This practical, applied program is recognized throughout the region for its outstanding graduates. Most alumni of the program serve as agency directors, department heads, and staff planners at the local, regional, and state levels. Some graduates work as generalists while others are specialists in GIS, housing and community development, environmental and coastal planning, historic preservation, transportation planning, or economic development. A growing number are employed in the private sector as developers, banking professionals, market research and site location analysts, land development and urban design consultants, public-private partnership consultants, and other consulting firms.

Admission Requirements

1. A bachelor's degree from an accredited college or university
2. A satisfactory academic record, particularly in the last two years of undergraduate work
3. An on-campus interview (highly recommended)

4. Three letters of recommendation with at least two from current or former professors

5. Completion of the Graduate Record Examination

6. A personal statement of objectives, briefly describing (in one to two pages) the applicant's interest in planning in general and Clemson's program in particular

Courses in statistics and economics are highly recommended. International students are required to submit TOEFL scores.

Deficiencies in any of these areas may be remedied after enrollment in the graduate program. Postbaccalaureate status may be recommended in some cases.

Requirements for Degree Candidacy

The two-year Master of City and Regional Planning degree requires a minimum of 55 credit hours. The program contains a 28-credit core curriculum, a three-credit summer internship, 15–18 credit hours of approved concentration/elective courses, and 6–9 hours of research and terminal project or thesis. The core courses include planning and substantive theory, analytical methods, implementation techniques and applications. The concentration area allows the student to develop further expertise in a particular area, if desired. A summer internship between the first and second years requires ten weeks of supervised professional employment for another three credits. If approved, students may take additional coursework in lieu of the internship. An oral examination is required to present and defend the results of the terminal project or thesis.

Requirements for Awarding of a Degree

Thesis Option

1. A minimum of 55 hours of coursework with a B average in the student's prescribed professional curriculum, including the thesis, is required.
2. A nine-credit-hour planning thesis must be completed satisfactorily. Only those students who have been approved by the Planning faculty and have performed satisfactorily on the comprehensive examination will be permitted this option.
3. The final oral examination requires satisfactory answers to questions concerning the student's thesis and concentration area.

Nonthesis Option

1. A minimum of 55 hours of coursework with a B average in the student's prescribed professional curriculum is required.
2. An approved six-credit-hour terminal project sequence must be completed satisfactorily. Students must perform satisfactorily on a comprehensive examination covering the core planning courses before being permitted to write the terminal project.
3. The final oral examination requires satisfactory answers to questions concerning the student's terminal paper and concentration area.

CONSTRUCTION SCIENCE AND MANAGEMENT

Master of Construction Science and Management Certificate

The Master of Construction Science and Management program provides students with a high level of skill and understanding in the technical areas of construction project administration and control. Substantial emphasis is placed on advanced study in the field of business, in new and emerging techniques for construction project delivery systems, and in the administration of the construction firm.

The number of credit hours required for the MCSM degree varies according to each student's undergraduate degree. For those who have the required undergraduate skills and knowledge, the program consists of 36 credit hours, of which at least 15 must be from the department core (C S M 860; 861; 862; 863; 864; 865; 889 or 891) and C S M 852. In cases where the candidate does not have the necessary prerequisite skills and knowledge, additional coursework beyond the 36 credit hours is required. Each application is evaluated as to the needed additional coursework. If deficient courses are noted, the candidate may be placed in a postbaccalaureate status.

This program is also available to off-campus students through the Office of Off-Campus, Distance, and Continuing Education. Call 1-888-CLEMSON (1-888-253-6766) for more information.

Admission Requirements

1. A bachelor's degree in construction science, construction management, building construction, or related area is required. Applicants from other disciplines may be admitted but may be required to remedy any deficiencies in coursework to provide the prerequisite skills and knowledge for the program.

2. Acceptance must be granted by the Office of Graduate Admissions and the Department of Construction Science and Management. University acceptance is based on performance in previous undergraduate studies and a satisfactory score on the GRE. In addition, acceptance by the department is based on performance in undergraduate studies, three letters of recommendation, and acceptance by the department Graduate Admissions Committee.

3. Each applicant is required to have one year of construction experience prior to being admitted to the program. Applicants must submit a detailed résumé of construction experience.

Requirements for Degree Candidacy

1. The Master of Construction Science and Management degree requires a minimum of 36 credit hours as detailed above. In cases where the candidate does not have the necessary undergraduate prerequisite skills and knowledge, additional coursework beyond the 36 semester hours may be required as noted above.

2. Each student is required to have one year of construction-related experience prior to being admitted to the program.

Requirements for Awarding of a Degree

Thesis Option

1. A minimum of 36 credit hours of coursework with a B average in the student's prescribed curriculum, including thesis, is required.

2. A thesis on a construction-related topic must be completed satisfactorily. Up to nine semester hours of thesis credit may be taken. Thesis credit is included as part of the department's core. Approval must be received from the student's advisor prior to selecting the thesis option.

3. Performance on a final oral examination relating to the student's thesis and program of study must be satisfactory.

Nonthesis Option

1. A minimum of 36 credit hours of coursework with a B average in the student's prescribed curriculum is required.

2. A special research design problem on a construction-related topic must be completed satisfactorily by taking C S M 889, which is included as part of the department's core. Approval must be received from the student's advisor for the topic of the research prior to registering for the course.

3. Performance on a written comprehensive examination covering the student's program of study must be satisfactory.

4. Performance on a final oral examination relating to the student's program of study must be satisfactory if the student has not performed satisfactorily on the written comprehensive exam. The oral exam is required only if the student did not perform satisfactorily on the written exam.

Certificate of Construction Science and Management

Clemson University's Certificate Program in Construction Science and Management provides qualified students the opportunity to take a selection of advanced construction management courses without having to commit time and resources toward the pursuit of a master's degree. Students receive three hours of college credit for each course taken and a certificate upon completion of all six courses.

Prospective students apply in the same manner as current graduate students. A bachelor's degree in construction science, construction management, building construction, or related area is required. There is no requirement to take the GRE or TOEFL.

A student enrolled in the certificate program who wishes to be admitted into the MCSM graduate program must meet all admission and degree requirements in effect at the time of application. The student may transfer up to 12 credit hours from the certificate program to the Master of Construction Science and Management degree; therefore, the decision must be made by the time the student has completed four courses (12 credit hours).

Admission Requirements

1. A bachelor's degree in construction science, construction management, building construction, or related area is required. Applicants from other

disciplines may be admitted but may be required to remedy any deficiencies in coursework to provide the applicant with the needed prerequisite skills and knowledge for the Construction Science and Management certificate program.

2. Acceptance must be granted by the Department of Construction Science and Management. Acceptance is based on performance in previous undergraduate studies, three letters of recommendation, and acceptance by the department graduate admissions committee.

3. Each applicant is required to have a minimum of one year of construction experience prior to being admitted to the program. Applicants must submit a detailed résumé of construction experience.

Requirements for Awarding of a Certificate

Completion of the following courses with a B or better is required: C S M 860, 861, 862, 863, 864, 865.

DIGITAL PRODUCTION ARTS

Master of Fine Arts

The Digital Production Arts program at Clemson University is a professional degree program aimed at producing graduates who will be sought by the growing electronic arts industry, particularly by those companies engaged in special effects production within the entertainment and commercial video, film, and gaming industries. The program is offered jointly with the College of Engineering and Science and offers a unique blend of instruction from art, computer science, computer engineering, graphic communications, performing arts, philosophy, and psychology, together with newly designed courses targeted at specific production techniques.

Admission and Financial Aid

Applicants are required to submit GRE general test results and a portfolio of artistic work that may include CD-ROMs, videos, slides, etc. Assistantships will be available to qualified applicants. Interested domestic students are encouraged to apply by March 1 for fall admission.

Requirements for Awarding of a Degree

The degree requires 60 hours, 18–24 of which are devoted to the visual arts studio wherein the student participates in group and individual animation projects, providing material for his/her professional quality demonstration video. Of the remaining 36–42 credit hours, 18 must come from the core courses, six from the master's thesis, and 12 from electives or foundation courses, three hours of which must come from one of the required electives below. Some beginning students may need postbaccalaureate work in the fundamentals of computing or visual arts, so foundation courses are offered. A maximum of five hours of foundation courses may be counted toward the degree. The normal course of study requires two years.

Foundation Courses—two courses selected from ART 803, CP SC 801

Core courses—ART 613, 821, CP SC 605, 611, 815, THEA 687. At least one course must be selected from A H 630, 632, ENGL 650, (COMM) 651, 853, PHIL 845.

Electives—selected from ART 605, 607, 609, 611, CP SC 805, 808, E CE 847, G C 801, MUSIC 680, PSYCH 823, THEA 697.

Individual and/or Group Study Courses—ART (CP SC) 860 and ART 891 or CP SC 891 (Master's Thesis Research)

A supervisory board consisting of the program director and five faculty—two from Art, two from Computer Science, and one from Performing Arts—administers the program. The degree capitalizes on Clemson's well-known strengths in computer graphics (virtual reality systems), image processing, photography, art, film, and theatrical design.

ENGLISH

Master of Arts

Certificate

Applicants for the Master of Arts degree in English must present at least 12 credit hours of undergraduate English courses beyond the sophomore level; for the MEd degree in Secondary Education with an emphasis in English, applicants must present at least nine. Entrance credits should include one course each above the sophomore level in Shakespeare and in English and American literature; students deficient in these may seek provisional admission.

MA students complete 25 credit hours of approved graduate courses and write a thesis, which may be developed with the approval of the Graduate Committee, from any interest area covered by the MA program. The nonthesis option requires 37 credit hours. All students must demonstrate a reading knowledge of an approved foreign language.

At the core of the MA program is a 10-hour requirement, including ENGL 800 and one course from each of the following groups:

British Literature—ENGL 805, 808, 811, 814, or an appropriate section of 831

American Literature—ENGL 820, 823, or an appropriate section of 831

Language and Composition—ENGL 885 (required of graduate teaching assistants), 801, 802, 803, 832, 835, or an appropriate section of 831

MEd students in Secondary Education with an emphasis in English complete a total of 37 graduate credits, including ENGL 685 and 800.

Candidates for the MA and MEd degrees also must demonstrate proficiency in composition and pass a comprehensive oral examination.

Certificate in Writing Assessment

The certificate program in Writing Assessment consists of 18 credit hours of coursework. That coursework is flexible depending on the targeted needs of the student. The full certificate requires ENGL 871, three hours in writing, and twelve elective hours selected from ENGL 872, 873, 874, 875, and 876.

ENVIRONMENTAL DESIGN AND PLANNING

Doctor of Philosophy

The PhD Program in Environmental Design and Planning is an interdisciplinary, three-year post-master's degree program consisting of 71 hours. In most cases, students enter the program with a master's degree in architecture or landscape architecture, city and regional planning, or construction science. Because of the program's interdisciplinary orientation, students may be drawn from other disciplines including engineering, business, the social sciences, and humanities. Students from those program areas may be required to take prerequisite coursework. Students with advanced preparation may take slightly less than three years.

The curriculum is divided into five content areas as indicated below. Those content areas include core courses, concentration courses, elective courses, comprehensive examination, and dissertation research. Students will select a field from the traditional disciplines of architecture, landscape architecture, planning, or construction to build disciplinary as well as interdisciplinary foundations. Areas of specialization will be developed subject to faculty expertise and student interest. Areas of specialization might be drawn from such areas as urban design, health care, energy, development, community design, restoration, sustainability, landscape ecology, and building practice and technology.

Core Courses—The core consists of 23–26 hours of coursework and includes advanced theory/history, advanced methods courses generally taken outside the college, a readings course within a primary field area, a contemporary issues seminar, courses in research design and instructional delivery, and a colloquium and workshop. The core provides a foundation with some flexibility to tailor the curriculum to individual needs within primary fields of study as well as a forum to address issues of the built environment in an interdisciplinary setting.

Concentration Courses—These courses may be taken within or outside the college. Students develop an individualized course of study to reflect their focus and career objectives. Coursework must be approved by the faculty advisor and committee members.

Electives—These courses add additional breadth and depth to the program. Students may add to their concentration coursework, select diverse offerings to complement the concentration, or develop an additional area of focus.

Degree Plan and Comprehensive Exam—Students are assigned an advisor upon entering the program. A program evaluation is conducted and a dissertation advisor and dissertation committee are selected at the end of the first full year of study. A curriculum plan for the remainder of the program is developed at that time. Comprehensive and oral examinations are administered following completion of the second full year. Dissertation credit cannot be taken until comprehensive exams are scheduled.

Dissertation Research—Students develop a dissertation in their area of concentration. A minimum of 24 hours in dissertation research is required.

HISTORIC PRESERVATION

Master of Science

Certificate

The Master of Science in Historic Preservation degree is a professional degree program designed for students who will specialize in working with historic buildings, landscapes, and the decorative arts. It is a dual degree program with the College of Charleston and is administered through Clemson's Department of Planning and Landscape Architecture. The program uses Charleston and the historic environs of South Carolina as a living laboratory. The size of the program is restricted to ensure focused research with the faculty. Coursework emphasizes studios, labs, and field seminars incorporating Charleston's rich community of preservation specialists as well as distinguished visiting faculty and researchers in the Graduate Center in Historic Preservation.

Students are admitted into the program from a variety of undergraduate disciplines relating to the built environment. A portfolio with samples of work related to the built environment is encouraged, and students of the humanities and sciences are encouraged to apply.

Program Requirements

The 54-credit program is structured in sequential layers, beginning with an initial core semester devoted to the analysis and documentation of historic sites, followed by a more advanced studio-focused semester organized around the development of a preservation project. The second year focuses on advanced analysis and conservation studies, followed by a final semester of preservation administration done in conjunction with the student's thesis focus.

Thesis proposals are defended in the third semester of the program. Thesis projects are original research and incorporate each student's specific focus in the discipline of historic preservation. Projects using the historic resources of Charleston and its environs, or other suitable historic sites, are encouraged.

Professional internships are available through a variety of Charleston preservation initiatives, the national network of preservation specialists, as well as opportunities with national organizations such as the Historic American Building Survey and the National Trust for Historic Preservation.

Certificate in Historic Preservation

The Certificate in Historic Preservation is designed to enhance a variety of other degree programs at Clemson through advanced studies in historic preservation. The graduate certificate uses the first semester curriculum of the graduate program in Historic Preservation, otherwise known as the "foundation" semester, as a stand-alone semester in Charleston. This Charleston-based semester focuses on documentation and analysis of the design and craftsmanship of the historic city and exploration of the philosophy of preservation on site.

The 12-credit semester meets NCPE-mandated curriculum requirements. Prerequisites and further course requirements are determined by the student's degree program of study.

HISTORY

Master of Arts

Admission Requirements

Students are admitted to the graduate program upon the recommendation of the department's graduate program coordinator or department chair. All applicants to the MA program in History must submit the following to the Graduate Admissions Office:

1. A minimum score of 500 on the verbal section of the Graduate Record Examination (GRE) and a minimum score of 4 on the writing section. (GRE scores more than five years old relative to date of initial enrollment are not accepted.)
2. Final transcript(s) for the BA sent by the applicant's undergraduate school(s), showing a minimum grade-point ratio of 3.0 in history courses; and 2.5 in all courses during the last two undergraduate years
3. Three letters of reference, preferably from undergraduate professors
4. A sample term paper
5. A personal statement addressing the applicant's background in history, intended areas of specialization, and reasons for applying
6. A completed University application form

Additionally, if the applicant has (1) a grade-point ratio less than 3.0 in the History major for the BA degree and/or (2) a BA degree, including the major and minor, in subject(s) other than history, he/she will be required to take a minimum of four upper-level undergraduate history courses at Clemson or at another accredited university or college and receive a grade of B or better in each course before admission to the program. The only exception to this course requirement shall be persons who demonstrate that, as a part of their BA degrees, they completed a minimum of four upper-level undergraduate history courses with a grade of B or better. Any exceptions to these regulations require the consent of the department's Graduate Committee.

Application Deadline

Applications for fall semester must be postmarked no later than the previous April 15, and for spring semester no later than the previous November 1. Please note that consideration for assistantships takes place in January and February.

Requirements for Awarding of a Degree

The MA in History requires 30 credit hours in courses numbered 600 or above divided as follows:

1. HIST 881
2. HIST 820 or 872 and HIST 890
3. A minimum of nine additional credit hours in courses numbered between 800 and 894, excluding HIST 885, 890, and 891
4. A minimum of nine elective credits in graduate courses selected with the approval of the director of the graduate program
5. A minimum of five credits in HIST 891 (Master's Thesis Research), three of which should be taken in the second semester if enrolled full-time or within the first 18 credits in the program. Additionally, the

student must write a thesis acceptable to the department and must demonstrate reading knowledge of a foreign language. A final examination, which may be written, oral, or a combination of the two forms, is required of all candidates.

Students holding an assistantship in the Department of History who receive a grade lower than B in any graduate course may have their assistantships terminated.

LANDSCAPE ARCHITECTURE

Master of Landscape Architecture

The landscape architecture profession is broad and interdisciplinary. Practicing landscape architects work on a wide range of project types including, but not limited to, urban and community design, historic preservation, ecological restoration, parks and park systems, institutional landscapes, memorials, cemeteries, industrial site reclamations, golf courses, wilderness areas and trails, residential landscapes and gardens.

The profession is both an art and a science. Successful landscape architects are creative professionals who hold an environmental imperative and a social conscience. They are also excellent facilitators, able to bring numerous disciplines and professions together to work on complex projects in the landscape.

Like other universities in the United States, Clemson offers two Master of Landscape Architecture (MLA) tracks—a first professional degree and a second professional degree. Both tracks offer students an opportunity for in-depth study in one of the department's focus areas—community and landscape change, health and design, and landscape restoration (including landscape ecology, history and historic preservation). A more general emphasis on international study supports the three focus areas. Research and study in those important topics of national and international consequence further ensure the marketability of Clemson's MLA graduates.

To qualify for admission to the first professional degree, students must hold a bachelor's degree in any discipline from an accredited college or university. Students come from a range of disciplines such as planning, history, English, biology, geology, geography, environmental science, various social or natural sciences, art, or other disciplines.

Students in the two-year second professional degree must hold a five-year Bachelor of Landscape Architecture (BLA) degree. Students with other accredited design degrees such as Bachelor of Architecture (BArch) and Bachelor of Science in Landscape Architecture (BSLA, generally a four-year degree) will move into the first professional program but will be allowed to complete the work in less than three years, depending on individual backgrounds and experiences. Admission to the program is based on GRE scores, three letters of recommendation, academic background and related transcripts, statement of purpose, and work experience, if any. International students are expected to have exceptional TOEFL scores complementing the GRE.

First Professional MLA

The three-year first professional degree is designed to provide students with a professional education and also an opportunity for research and/or in-depth project work. Because students hold bachelor's degrees from an array of backgrounds, it is necessary for them to gain landscape architectural skills. Those proficiency courses are also required for professional accreditation.

Students begin the program with a rigorous summer experience that provides an in-depth orientation into the profession and discipline. In the first years of the program, students focus on corequisite proficiency requirements but will also take a few important graduate-level courses. More graduate-level work, project-oriented research connected to a team project, and/or thesis project are emphasized during the final year. Summer off-campus experiences are optional. Students take 45 credits of corequisite proficiency coursework, 48 credits of 800-level courses, and six credits of 600-level courses, for a total of 99 credits.

Second Professional MLA

The second professional degree in Landscape Architecture is a two-year program limited to students who hold an accredited five-year professional BLA degree. Second professional degree students take a total of 51 credit hours to earn the degree. Requirements include two 800-level seminars, one 800-level colloquium, and three 6-credit 800-level studios. In the final semester students choose between a six-credit 800-level collaborative studio or six thesis credits. Students are also required to complete a three-credit "Key Issues in Landscape Architecture" course. An external research methods course is required as are 12 elective credits (at least six credits must be at the 800 level). Summer off-campus experiences are optional. Like first professional degree students, second professional degree students may choose to engage in sophisticated team studio projects or complete individual thesis projects in the final semester.

PROFESSIONAL COMMUNICATION

Master of Arts

The Department of English offers an interdisciplinary Master of Arts degree in Professional Communication which combines work in theory and research with a comprehensive emphasis on written, oral, and visual communication. It prepares graduate students to be professional and technical communicators in industry and government and to be teachers of professional communication in two-year colleges. In addition, the program provides the background necessary for students who plan to pursue a PhD in rhetoric or technical communication.

This degree is designed for students with strong writing skills from all academic disciplines. The program accommodates students with undergraduate majors in technical and scientific fields, as well as those with humanities and business degrees.

The Multimedia Authoring Teaching and Research Facility and the Class of 1941 Studio for Student Communication give MAPC students access to corporate-style presentation and collaboration space as well as the newest computing hardware and software, enabling multimedia and Web design and production, digital video and audio editing, desktop publishing, and graphic design. Clemson's award-winning undergraduate writing programs and faculty with expertise in the teaching of writing allow MAPC students to work at the forefront of innovative writing pedagogy. The Campbell Chair in Technical Communication, the Pearce Center for Professional Communication, and the Effective Technical Communication Program in Engineering constitute a network of professors enabling students to work in professional communication in a variety of academic disciplines. The Usability Testing Facility allows students to conduct state-of-the-art usability research on interface designs, on-line documentation, and other publications. MAPC students wishing to pursue careers in the growing field of health communication also have the option of combining the Master's degree with the Health Communication Certificate program described below.

Additional information about the MAPC program is available at www.clemson.edu/caah/mapc/.

Admission Requirements

Applicants must hold a degree in any field from an accredited college or university, with a 3.0 grade-point ratio on a 4.0 scale; submit a satisfactory score on the GRE general test; submit at least two letters of recommendation from individuals familiar with the candidate's academic work and/or work experience; and submit a brief résumé, a one-page statement of purpose discussing why the candidate wishes to pursue the MAPC degree, and ten pages of workplace or academic writing.

Requirements for Awarding of a Degree

The MA in Professional Communication requires 30 credit hours beyond the BA or BS degree, distributed as follows:

1. Five core courses, which include ENGL 850, 851, 852, 853; and ENGL 856 or COMM 664.
2. Three or four electives in a specialty area chosen to meet professional goals. Possible electives include professional communication courses in writing, teaching, digital publishing, and corporate communication, as well as courses in related disciplines.
3. Candidates must demonstrate a reading knowledge of a foreign language and pass a qualifying examination on a reading list.
4. Students choose either to write a thesis based on research and a thorough analysis of a problem in professional communication (six credit hours) or to complete a project by solving a communications problem for a client in the professional world and by preparing a project portfolio (three credit hours).

Health Communication Certificate

An interdisciplinary Certificate in Health Communication is also available to students in the MAPC degree program and to practicing health professionals who already have graduate degrees or are pursuing graduate degrees in Nursing, Health Sciences, and many other fields. This 18-credit-hour certificate program offers students the ability to develop careers in writing for the pharmaceutical, scientific, medical, and/or health industries. It especially targets jobs in hospital systems, HMOs, clinics, CDC, and other local, national, and international health organizations. The certificate program is available through two tracks:

1. MAPC students who specialize in this field by taking ENGL (COMM) 804, 806, and (COMM) 807 to fulfill their MAPC program cognate requirements
2. Health professionals who need to update their communication skills to better meet the challenges of today's highly technological health settings

Unlike other programs in health communication, this program is geared toward the technological skills more applicable to today's health industry. In addition, the program can be customized to individual student needs, whether they be centered on technological skills available through the MAPC/HCC program or targeted for those who already have technical skills in health content and/or medical humanities. This program is interdisciplinary and includes both arts and sciences approaches to health messaging. Additional information is available at www.clemson.edu/caah/healthcomm/.

REAL ESTATE DEVELOPMENT

Master of Real Estate Development

The full-time, 54-credit, two-year professional Master of Real Estate Development (MRED) degree program is jointly offered by the Department of Planning and Landscape Architecture and the Department of Finance in the College of Business and Behavioral Science. Required courses are drawn from six disciplines: MBA, finance, law, architecture, construction science and management, and planning and landscape architecture.

A two-week South Carolina Coastal Real Estate Development Field Tour is required during Maymester. Students study developments in Myrtle Beach, Pawleys Island, Charleston, Beaufort, and Hilton Head prior to the required ten-week supervised professional summer internship. Other regional field trips occur in Charlotte, Atlanta, and nearby areas.

The program creates the educational opportunity for future development entrepreneurs to produce exciting, quality projects respecting environmental and economic sustainability, social consciousness, design excellence, and financial feasibility within the risk-reward framework. The development industry is complex and requires leaders trained from diverse disciplinary perspectives. The program primarily follows the principles of the Urban Land Institute (ULI), which acknowledges that development is a public-private partnership and that quality development requires integrating the perspectives of community, environment, and economics.

Some first-year students will obtain research assistant positions for ten hours per week, assisting professors in research at the Center for Real Estate Development. Second-year MRED students (some first-year students with experience) may work two days each week during the academic year at paid internships with local real estate entities. Positions typically require interns to have transportation throughout the metro area (up to a 60-mile radius). The program requires a 10-week summer internship with a real estate business anywhere in the world.

The program seeks an interdisciplinary student body, which is entrepreneurial yet team-oriented. No specific bachelor's degree is required. Work experience is not required, although it is preferred.

The program focuses on the "master builder" concept, the methodology promoting an entire vision for a community through sustainable design, creative financing, place-making, and healthy communities. A graduate will become a visionary who serves as a craftsperson and designer of neighborhoods and community development, one who recognizes the role of the developer in guiding the different aspects of creating the built environment—political, economic, physical, environmental, legal, and sociological parameters.

Additional information is available by e-mail from CURealEstate-L@clemson.edu or at www.clemson.edu/caah/pla.

Course Requirements

The Master of Real Estate Development Program requires a minimum of 54 credit hours (60 credits for students with no previous degree background and previous coursework in the field). Additional electives are based on class exemptions dependent on prior coursework.

Following is the required curriculum for students with no undergraduate background in the field:

First Year

First Semester

- 3 - C R P 602 Human Settlement
 - 3 - C R P 802 Site Planning and Infrastructure
 - 3 - M B A 819 Intro. to Accounting and Finance
(for non-business degree majors)
 - 3 - M B A (FIN) 836 Real Estate Principles
 - 3 - RED 800 Real Estate Development Process
-
- 15

Second Semester

- 3 - ARCH 820 Building Design and Construction Principles
 - 1 - C R P 830 Introduction to GIS
 - 3 - M B A 833 Real Estate Investments
 - 3 - M B A 842 Real Estate Valuation
 - 3 - RED 801 Real Estate Market Analysis
 - 1 - RED 810 Real Estate Seminar Roundtable
-
- 14

Maymester and Summer Session

- 3 - RED 802 Real Estate Dev. Field Tour Seminar
 - 3 - RED 811 Summer Internship in Real Estate Development
-
- 6

Second Year

First Semester

- 3 - C S M 866 Contractor Role in Development
 - 3 - LAW 848 Law for Real Estate Professionals
 - 3 - M B A 841 Real Estate Finance
 - 3 - RED 803 Public-Private Partnership Dev.
 - 1 - RED 810 Real Estate Seminar Roundtable
-
- 13

Second Semester

- 3 - C S M 862 Personnel Management and Negotiations
 - 3 - RED 804 Practicum in Master Planned/Resort Communities
 - 3 - RED 805 Practicum in Commercial Dev.
 - 3 - Elective
-
- 12

RHETORICS, COMMUNICATION, AND INFORMATION DESIGN

Doctor of Philosophy

The PhD program in Rhetorics, Communication, and Information Design features an interdisciplinary curriculum developed by faculty from Art, Communication Studies, and English. The curriculum provides a solid foundation in theory in addition to extensive training in research and practice.

Admission Requirements

Students admitted to the PhD program in Rhetorics, Communication, and Information Design must meet the following minimum requirements:

1. Minimum combined score of 1000 on the two objective sections (verbal and quantitative) of the Graduate Record Examination (GRE) and a minimum score of 4 on the analytical writing section. (GRE scores more than five years old relative to the date of initial enrollment will not be accepted.) Because of the strong communication component of the PhD program, non-native speakers of English must have a minimum TOEFL score of 550 (paper version) or 213 (computer version) in addition to the GRE scores.
2. Master's degree in Communication Studies, English, Art, Professional Communication, or other related field. A student with a master's degree in another field of study may apply to the program with the understanding that he/she may be required to complete prerequisite, master's-level courses in professional communication prior to full admission to the PhD program.
3. Minimum grade-point ratio of 3.5 in previous graduate work. The student must submit all transcripts of previous graduate and undergraduate work.
4. International students seeking graduate teaching assistantships, whose native language is not English and whose secondary education (and beyond) was not taught fully in English, must pass the SPEAK test of proficiency in spoken English. Specialists in English as a Second Language administer this test at Clemson. Prospective international teaching assistants will also undergo an interview during which their proficiency in spoken English will be evaluated by faculty members in the RCID program.

In addition, the student must submit the following:

1. Portfolio of previous graduate work, including a writing sample, preferably a sole-authored paper submitted in a graduate class
2. Personal statement addressing the student's interest and intent in pursuing the PhD in Rhetorics, Communication, and Information Design
3. Minimum of three letters of reference from academic sources
4. Completed application for admission

Program Requirements

Candidates for the PhD degree must complete 36 hours of graduate credit, including five required core courses (RCID 801, 802, 803, 804, 805), five cognate courses in a specialization, and six credit hours of studio research or applied project work (RCID 880). Candidates must also pass a comprehensive exam and write a dissertation.

VISUAL ARTS

Master of Fine Arts

The Master of Fine Arts degree is the terminal degree in the visual arts. Clemson University's program offers concentrations in the studio areas of drawing, painting, printmaking, ceramics, photography, and sculpture. Interdisciplinary and collaborative projects are encouraged within the department. The primary goal of the program is to provide students opportunities to develop a high degree of professional competence in their chosen area of concentration.

Admission Requirements

The Master of Fine Arts degree program in Visual Arts admits a limited number of talented and creative candidates on a competitive basis upon review of the following materials:

1. Bachelor's degree from an accredited college or university with a major in Visual Arts. Especially well-qualified persons from other disciplines or degree backgrounds with exceptionally strong portfolios may be accepted.
2. Minimum grade-point ratio of 3.0 on the last 60 major credit hours of undergraduate work
3. Portfolio documentation of the applicant's creative work. The portfolio should include 15–20 works, the majority of which represent the applicant's chosen field of study and should consist of 20 slides with an accompanying listing of the slides identifying size of work and media used. Supplemental materials such as photographs or digital prints of the artwork may also be included. The portfolio is reviewed by the Admissions Committee, composed of members of the faculty of the Department of Art. Applicants are also encouraged to arrange for a campus interview before or during the application process.
4. Three letters of recommendation from major professors, producing artists, or professional acquaintances who are familiar with the applicant's work and development in the visual arts

5. A one to two-page artist statement that provides insight into the development of the work completed to date. The statement should address ideas relative to form and content.

6. Statement of intent regarding applicant's interest in pursuing the graduate degree

7. No GRE is required.

Requirements for Degree Candidacy

The prospective candidate must have a review of his/her work at the end of each semester. It will be determined at this time if the student should continue or whether additional study is required at either the undergraduate or graduate level. Upon completion of 30 hours, the candidate must pass an oral review to determine readiness for thesis work. A Graduate Thesis Committee will be assigned at this time to assist the thesis development and concluding thesis exhibition.

The candidate must complete 30 hours and a full-time residency during the second year of study.

Requirements for Awarding of a Degree

1. A minimum of 45 credit hours with a B average or better in the student's professional curriculum, including 36 hours of ART 600- and 800-level studio courses and nine hours of A A H 600- and 800-level history of art and
2. A 15-credit-hour thesis culminating in satisfactory completion of a written documentary of the "thesis exhibition" and an oral examination by the graduate faculty

COLLEGE OF BUSINESS AND BEHAVIORAL SCIENCE

The mission of the College of Business and Behavioral Science is to develop leaders through education and research focused on human behavior and business practices in organizations, economies, and societies.

The College of Business and Behavioral Science offers advanced degrees in Accounting, Applied Economics, Applied Psychology, Applied Sociology, Business Administration, Economics, Graphic Communications, Human Factors Psychology, Industrial/Organizational Psychology, Management, and Marketing. The Master of Real Estate Development is offered in cooperation with the College of Architecture, Arts, and Humanities.

Courses are also offered in entrepreneurship, finance, law, marketing, and political science to provide program requirements and electives for students in other areas.

The graduate programs in the College of Business and Behavioral Science provide a wide range of opportunities for academic careers and for professional careers in business, industry, government, and nongovernment public sector organizations. Degrees offered in the business disciplines are fully accredited by the Association to Advance Collegiate Schools of Business (AACSB).

In the MA, MS, and PhD programs, extensive research programs involve graduate students in both theoretical and applied research and provide excellent opportunities for thesis and dissertation research. The professional master's degree programs feature assistantships and internships that provide opportunities for practical experience in the student's field. Financial aid, in the form of fellowships and teaching and research assistantships, is available for full-time participants in all graduate programs.

In addition to a full range of graduate programs offered on the main Clemson campus, some degree programs may be completed via off-campus evening course offerings. The Master of Business Administration (MBA) degree is offered at the University Center of Greenville.

Additional information is available at business.clemson.edu.

ACCOUNTING

Master of Professional Accountancy

The Master of Professional Accountancy (MPAcc) degree program prepares students to begin careers in public accounting or further graduate study. The program requires 30 credit hours and ACCT 856, 857, 858, and 859 and is open to students with appropriate backgrounds. The program accommodates full- and part-time students. Full-time students are able to complete the program in one year.

The MPAcc program recognizes the evolution of the theory and practice of financial reporting, auditing and taxation, technological advances in managing data, and increases in the volume and scope of authoritative pronouncements from the FASB, SEC, and IRS. Two specializations are available: Assurance Services and Taxation. The program is accredited by AACSB, International.

Applicants should hold a bachelor's degree from an institution whose scholastic rating is acceptable to the Graduate Admissions Committee of the School of Accountancy and Legal Studies. Admission to the program is based on academic record and score on the Graduate Management Admission Test (GMAT). Letters of recommendation and relevant work experience also may be considered. Applicants should have completed a basic business core of at least 30 credit hours, as well as the following accounting prerequisites: intermediate accounting (at least six credit hours), cost accounting (three credit hours), individual income tax (three credit hours), auditing (three credit hours), and accounting information systems (three credit hours). Current information is available at business.clemson.edu/Account/.

APPLIED ECONOMICS

Doctor of Philosophy

The graduate program in Applied Economics utilizes the facilities and faculty of the Department of Economics and those of the Department of Applied Economics and Statistics in the College of Agriculture, Forestry, and Life Sciences. Students may carry out their dissertation research under the direction of a faculty member from either department.

Applicants to the PhD program should have a strong background in economic theory and statistics. The program has required fields in these areas. Students choose two additional concentrations from financial economics, labor economics, monetary economics, environmental economics, industrial organization, public sector economics, and other fields supported by departments across the University.

APPLIED SOCIOLOGY

Master of Science

The Department of Sociology offers the MS degree in Applied Sociology emphasizing practical and theoretical knowledge in the areas of industrial and organizational sociology and focusing on the acquisition of social research skills, theory application, and practical field experience. Students are prepared for employment in federal, state, and local government agencies; in industry and related agencies; and to pursue a doctorate.

Applicants must hold a bachelor's degree from an accredited degree program; must have completed a minimum of 15 undergraduate credit hours in sociology or another social science discipline that includes at least one course each in statistics, research methods, and sociological theory; must submit GRE scores on the verbal, quantitative, and written sections (satisfactory scores normally include a minimum of 500 on the verbal and quantitative sections of the test and a 4.0 on the written section); must submit three letters of recommendation, at least two of which are from faculty members of the applicant's previously attended college or university; and must submit a 500-word essay on career aspirations and goals, explaining how completion of this program in Applied Sociology will assist in achieving these goals.

Students selecting the thesis option are required to complete a minimum of 34 credit hours of coursework including SOC 803, 805, 807, 810, 830, 895, and either ANTH 603 or SOC (R S) 671. In addition, students choosing the thesis option are required to complete six hours of thesis credit (SOC 891) and successfully defend a formal thesis. Students choosing the nonthesis option must complete 40 hours of coursework including SOC 803, 805, 807, 810, 830, 895 and either ANTH 603 or SOC (R S) 671. In addition, students selecting the nonthesis option must pass a departmentally administered comprehensive examination. Students must demonstrate competence in basic statistics by passing a departmentally administered competency examination or by earning a B in EX ST 801. A six-hour internship in an applied setting is required of all students. The field placement is coordinated by the student, the graduate director, and the on-site supervisor. Typically, the internship is completed in the summer between the first and second years of the program, but only after completing a minimum of 12 credit hours of 800-level coursework. In exceptional circumstances, the graduate coordinator may approve the substitution of six hours of appropriate coursework for the field placement when the student has had work experience comparable to the placement.

BUSINESS ADMINISTRATION

Master of Business Administration

The Master of Business Administration program provides an in-depth approach to business education, with opportunities to engage in real-world projects and professional development activities. MBA students come from a wide variety of backgrounds and may pursue a second, dual graduate degree, sharing some content between programs. Common second degrees include MS in Engineering, MS in Marketing, MS in sciences and various PhD degrees. Additional information is available at www.clemson.edu/mba or by e-mail at MBA@clemson.edu.

The Clemson MBA is offered through two curricula: Career Launch and Career Accelerator. The Career Launch curriculum is offered on the Clemson campus and targets non-business majors who are relatively new to their careers or international applicants who are new to the U.S. The program typically starts in the fall although some students may start earlier, taking strengthening courses. The first year provides a strong foundation in the core business areas. In the second year, students pursue an emphasis area such as Innovation and Entrepreneurial Leadership, Supply Chain and Information Management, Real Estate, Marketing Management, or an area in which the student is pursuing a second graduate degree. During the summer, students typically participate in internships or study abroad.

The Career Accelerator curriculum is pursued by experienced professionals and is conducted on the Clemson campus or at the University Center in Greenville, SC. Students may enter the program in any semester and, depending upon where they are taking classes, have an opportunity to pursue an emphasis in Health Services, Innovation and Entrepreneurial Leadership, Supply Chain and Information Management, Marketing Management, or Real Estate. Full-time students may complete the program in one to one and one-half years. Part-time students, taking one to two classes per semester, generally complete the program in three to four years.

Admission is based on standardized test scores (GMAT or GRE, TOEFL for non-native English speaking applicants), two letters of recommendation, academic background (transcripts), work experience (résumé), and an interview. A minimum of two years of post-degree, relevant work experience is required for participation in the Career Accelerator curriculum and for business majors. A separate fee structure applies to courses delivered in Greenville.

ECONOMICS

Master of Arts

Applicants to the MA degree program must have completed at least 12 credit hours of undergraduate economics, including a course in intermediate price theory. A background in mathematics, including at least one course each in calculus and statistics, is also required. When necessary, the economic theory, mathematics, and statistics courses may be taken at Clemson University.

The graduate program includes at least one course in econometrics and a minimum of two courses in economic theory. Program concentrations in financial economics, labor economics, monetary economics, environmental economics, industrial organization, and public sector economics have been designed for students interested in these areas.

Students pursuing a terminal MA degree must complete 24 credit hours of coursework and submit an approved thesis. Students continuing beyond the first year may receive an MA degree upon the completion of the PhD core courses with at least a B average. With the permission of the graduate coordinator, a maximum of six hours of course credit may be earned for graduate courses taken at Clemson outside the Department of Economics. All remaining courses must be taken within the department.

Combined BA/MA in Economics

The Department of Economics allows students to count up to 12 hours of graduate credit (800-level courses) toward both the bachelor's and master's degrees. Students participating in this program must have a minimum cumulative grade-point ratio of 3.4 and be admitted to the Graduate School prior to registering for graduate courses. Details of the suggested curriculum and program information are available from the Department of Economics. Application details are available in the *Undergraduate Announcements*.

GRAPHIC COMMUNICATIONS

Master of Science

The Master of Science in Graphic Communications degree program prepares students for technical, creative, or professional careers in graphic communications, the third largest manufacturing industry in the United States. The program serves the needs of graphic communications, graphic arts, printing management, or graphic design graduates from other institutions, as well as undergraduates with degrees in engineering, manufacturing, computer science, communications, technology, and various business fields who want to transition into graphic communications fields.

The MS program is enhanced by Clemson's undergraduate program of more than 400 students and works closely with Clemson's nationally recognized Packaging Science program. Industry supports well-equipped G C laboratories. Graduates are placed in positions in a variety of printing, packaging, publishing, imaging, and related industries in management, marketing, sales, customer service, creative, technical, scientific, and academic positions. Placement rates are consistently high.

Program entrance is available fall, spring, and first or second summer terms. Requirements for the program include 33 credit hours of graduate courses for a nonthesis option or 30 hours with a thesis. Within the total requirements, at least 17 hours will be in G C technical/managerial courses; seven will be research related; six credits will be from outside the Graphic Communications Department; and at least one-half will be at or above the 800 level. Based upon applicant's undergraduate coursework and work experience, prerequisite courses may be required in specific areas. Students without relevant work experience will also complete an industrial internship.

In addition to the standard Application for Admission, the Graphic Communications Department admissions committee requests a narrative of approximately two pages in length, to include related and nonrelated work history, educational background, current position and an explanation of how Clemson's MS in Graphic Communications program relates to the applicant's professional goals. A separate résumé should accompany the narrative.

MANAGEMENT

Master of Science

Doctor of Philosophy

Master of Science

The Master of Science program in Management (MSM) prepares professionals to be effective leaders in supply chain, innovation, and information technology management. Graduates will have the advanced technical, entrepreneurial, and leadership skills necessary to succeed as mid- or upper-level managers in manufacturing, service, and consulting organizations. The MSM program also prepares qualified students for further doctoral study in the fields of supply chain and operations management and information systems management. MSM students benefit immensely from the focused curriculum, close coordination of courses with the MBA program, and from the small class sizes.

The program requires a Business undergraduate or graduate degree. The MSM curriculum requires 30 credit hours consisting of seven core courses, one elective course, and a six-credit-hour master's thesis. Core and elective courses cover a broad range of topics in supply chain and information technology management and in entrepreneurship and innovation management. The Graduate Programs Committee will approve the final program for each student based on his/her background, interest, and availability of courses.

Doctor of Philosophy

The PhD program in Management is designed to provide advanced education for students of outstanding ability who desire to pursue careers in academic research institutions. The program currently features two distinct, focused tracks: Supply Chain and Operations Management and Information Systems.

The PhD track in Supply Chain and Operations Management (SC&OM) is a balanced program of management theory, analytical techniques, and research methodologies that focuses on the manage-

ment of operations, technology, and supply chains. The supply chain and operations functions—managing the processes by which goods and services are sourced, created, and distributed—are critical to the success of virtually all businesses and increasingly important to globalization.

The PhD track in Information Systems (IS) focuses on cutting edge IS research addressing the complex question of “how do we make organizations better through the deployment of information systems?” This question is examined at the individual, group, organizational, and inter-organizational levels through a variety of theoretical perspectives using a rich repertoire of research methodologies.

The coursework for the PhD in Management includes a rigorous research methodology set that is common to both tracks and intellectually stimulating and challenging track-specific foundation, advanced methods, and subject-related seminars. In addition, the program requires a comprehensive examination and successful completion of the doctoral dissertation. A variety of learning experiences is incorporated into both tracks, including the development of conceptual frameworks and theories, qualitative case and empirical studies, field projects, and in-depth research. Within the Department of Management, PhD students have tremendous opportunities to conduct cross-disciplinary research between SC&OM and IS or with high-quality faculty in entrepreneurship, strategic management, and human resources management. The goal is to position graduates for scholarly academic careers at colleges and universities throughout the U.S. and the world.

The PhD program in Management is designed for full-time students who remain on-campus during the entire duration of their study. Students may enter this program in the fall semester only (starting mid-August). Students with Bachelor’s or Master’s degrees in Business can typically complete the program in four years. Students with non-Business degrees will need to complete background courses that may lengthen the program duration.

MARKETING

Master of Science

The Master of Science in Marketing degree program advances students’ knowledge and expertise in marketing theory and practice and prepares them for careers in marketing analysis, research, management, and scholarship. A coordinated curriculum of quantitative and analytical skills development, research methods, consumer analysis, and strategic marketing analysis provides students with the necessary background to pursue careers in marketing research, analysis, and policy and/or as a platform for further education to prepare students for careers in academe. This is accomplished through rigorous coursework and seminars and a major research project. This one-year master’s degree is designed to enhance the skills and training of students with prior academic and work experience in business. Applicants should have an undergraduate degree in business from an accredited college or university. In addition, it is preferred that incoming students have some professional work experience. Students

applying to the MS in Marketing program who are not graduates of an AACSB-accredited college or school of business administration will be required to demonstrate completion of three credit hours of collegiate microeconomics, six hours of calculus, and a junior-level course in marketing, or equivalent, to be considered for the program.

The Master of Science in Marketing degree requires completion of 30 credit hours of graduate marketing and related coursework. Core classes include EX ST 801, MKT 860, 861, 862, 863, 865, 870. In addition, three credit hours in approved analytical methods and three in advanced topics in marketing are required.

MBA

See Business Administration on page 33.

PSYCHOLOGY

The Department of Psychology offers PhD degrees in Industrial/Organizational Psychology and in Human Factors (Engineering) Psychology and an MS degree in Applied Psychology with concentrations in Industrial/Organizational Psychology and Human Factors Psychology. These programs are designed to provide the student with the requisite theoretical foundations, skills in quantitative techniques and research design, and practical problem-solving skills to address human problems related to work. The Department of Psychology is a member of the Council on Applied Master’s Programs in Psychology. The Human Factors Concentration is fully accredited by the Human Factors and Ergonomics Society.

APPLIED PSYCHOLOGY

Master of Science

HUMAN FACTORS PSYCHOLOGY

Doctor of Philosophy

INDUSTRIAL/ ORGANIZATIONAL PSYCHOLOGY

Doctor of Philosophy

A formal thesis and supervised field internship are required for the MS degree. MS students complete 45 credit hours, including six hours of thesis credit and six hours of credit for the internship. Typically, the internship is completed in the summer between the first and second years of the program. In some cases, six credit hours of approved electives may be substituted for the field internship.

Students in the doctoral programs are expected to satisfy the master’s program requirements plus an additional 45 credit hours prior to receiving the doctorate. In addition to the required courses, a doctoral program must include 18 hours of dissertation research and an oral dissertation defense. Students are admitted to candidacy for the PhD degree upon successful completion of a comprehensive examination.

Applicants should have an undergraduate degree with a major in psychology or a related field from an accredited college or university. Students with a major other than psychology should have a minimum of 15 semester hours beyond the introductory psychology survey course. Applicants to the master’s program in Applied Psychology and the PhD program in Human Factors Psychology must also have at least one undergraduate course in calculus. All applicants must submit scores from the general portion of the GRE. Applicants must also submit three letters of reference, a personal interest statement, and a résumé. The application deadline is December 31. Program information and application requirements are available at www.clemson.edu/psych/.

REAL ESTATE DEVELOPMENT

Master of Real Estate Development

The Master of Real Estate Development Program, jointly administered by the Department of Finance and the Department of Planning and Landscape Architecture in the College of Architecture, Arts, and Humanities, creates the educational opportunity for encouraging future development entrepreneurs to produce exciting, quality projects respecting environmental sustainability, social consciousness, design excellence, and financial feasibility within the risk-reward framework. See page 30 for the complete program.

TECHNOLOGY ENTREPRENEURSHIP

Certificate

The Certificate in Technology Entrepreneurship is available to graduate students in engineering and science disciplines across campus. The certificate is intended to serve those students who envision an entrepreneurial career as their long-range career goal, who want to be involved in new product and new business activities within a corporate setting, or who seek a better understanding of the process of commercializing inventions.

The program requires E L E 600, 800, and one of the following: an additional section of E L E 800, M B A (MGT) 845, or M B A 875.

COLLEGE OF ENGINEERING AND SCIENCE

The College of Engineering and Science offers advanced degrees in Automotive Engineering, Bioengineering, Biosystems Engineering, Chemical Engineering, Chemistry, Civil Engineering, Computer Engineering, Computer Science, Digital Production Arts, Electrical Engineering, Environmental Engineering and Science, Environmental Toxicology, Hydrogeology, Industrial Engineering, Materials Science and Engineering, Mathematical Sciences, Mechanical Engineering, Physics, Polymer and Fiber Science.

Courses are offered in astronomy, engineering graphics, and environmental science and policy to provide electives for students in other areas.

Degrees offered are the Master of Engineering, Master of Science, and Doctor of Philosophy. The MS and PhD programs serve primarily full-time graduate students. Industrial residency programs leading to the Master of Science degree are available in certain engineering departments. Financial aid, in the form of full and partial fellowships and teaching and research assistantships, is available. Other financial aid packages are available to outstanding applicants. A broad and vigorous research program provides excellent opportunities for thesis and dissertation research.

The Master of Engineering program is open to individuals who are interested in professionally oriented advanced study. Requirements for the program are a baccalaureate degree from an ABET-accredited engineering program or equivalent, academic and professional records which indicate motivation for and the ability to complete additional professional study, and acceptance by the chair of the department in which the individual plans to major and by the Dean of the College of Engineering and Science.

Graduate engineering education opportunities for practicing engineers are available in two disciplines. The Department of Electrical and Computer Engineering offers off-campus graduate courses leading to the Master of Engineering degree through satellite broadcasts, Internet, and DVD. The Department of Mechanical Engineering offers selected off-campus graduate courses at the University Center of Greenville. Furthermore, graduate courses in both disciplines are offered on-campus during the late afternoon/early evening once a week.

AUTOMOTIVE ENGINEERING

Master of Science

Doctor of Philosophy

The Master of Science and Doctor of Philosophy degrees in Automotive Engineering prepare a new generation of engineers to deal with the complex technological, environmental, and globalization issues facing the automobile industry.

The big challenge facing the industry is the integration of diverse technologies in the automobile and its cost effective and environmentally responsible manufacture, all being done in a global network with people of different backgrounds and cultures. The Automotive Engineering programs equip students with the basis, depth, and domain knowledge needed for master's and doctoral-level expertise in systems integration and vehicle systems engineering and the ability to work globally. Graduates of the program are able to lead teams of culturally diverse individuals to produce an integrated automobile platform or to work in research laboratories involved with the design of new products in the automotive field. While the program is geared toward the automobile industry, it produces strong linkages with the aerospace and other industries within the state, region, and nation as some of the challenges faced by the automotive industry are also faced in other sectors.

Master of Science

Admission to the MS program occurs in the fall semester only. Students are required to hold a BS degree from a recognized relevant engineering or science discipline and the equivalent of two years of postbaccalaureate full-time work experience in industry. Students have the opportunity to tailor the program either in the functional aspects or systems aspects of automotive engineering through appropriate course choices.

The program is divided into four content areas, consisting of 36 credit hours of coursework and six hours of project work, as follows:

Core Courses—AU E 880, 881, 882, 883

Automotive Engineering Track—18 credit hours in two or three track areas with nine hours in automotive engineering courses and nine hours based on the student's interests and specialization.

Business or Related Field—a minimum of six hours in a concentration area or minor approved by the advisory committee

Internship—a six-credit-hour internship of six months duration in an industrial setting

Foreign language proficiency is required as an outcome of the program.

Doctor of Philosophy

Students are admitted into the PhD program in the fall, spring, and summer terms. Minimum admission requirements include a bachelor's or master's degree in a recognized relevant engineering or science discipline. Students entering the program directly with a BS degree must meet the entrance requirements

for the MS degree and have a grade-point ratio of 3.5 or higher in their undergraduate programs. Students with an MS degree in a recognized relevant engineering or science discipline are not subject to the two years of postbaccalaureate full-time industrial experience requirement.

Program requirements are as follows:

Core Courses—AU E 880, 881, 882

Automotive Engineering Track—minimum of six hours (two AU E courses from two track areas)

Discipline-Specific Courses—no minimum requirements, typically five additional courses

Business or Related Field—minimum of three hours in a directed, nontechnical field

Technical Courses—minimum of nine hours in a concentration area outside the discipline or a technical minor

Dissertation—18 credit hours

Foreign Residency Requirement—six-month residency at a foreign research laboratory or university

BIOENGINEERING

Master of Science

Doctor of Philosophy

Bioengineering is the application of engineering and scientific principles to understand and solve medical problems. As medical technology has rapidly developed over the past four decades, the demand for qualified bioengineers has dramatically increased. Career opportunities for bioengineers range from teaching and conducting basic research in academia to research and development work in the growing medical product industry. Employment opportunities are also available in independent research laboratories, hospitals, and federal agencies such as the Food and Drug Administration or the National Institutes of Health.

Clemson University's Bioengineering Program is one of the oldest in the world; its PhD program began in 1963, and its MS program was added in 1966. Historically the department is widely recognized to have pioneered the field of biomaterials. Today the Department of Bioengineering maintains its focus on biomaterials and related areas, including tissue engineering, regenerative medicine, drug delivery, biomechanics, and biosensing. Although Clemson University does not have a medical school, the Bioengineering Department maintains close collaborative ties with several medical centers in the Carolinas. In particular, Clemson has a formal partnership with the Medical University of South Carolina, located in Charleston, and maintains full-time bioengineering faculty and students at both campuses. Interactions between the two institutions are facilitated by state-of-the-art video-conferencing facilities, which enable students to take classes and interact directly with faculty at either location. A joint MD/PhD program is provided for qualified students as part of this partnership.

Applicants to the Bioengineering programs typically hold a Bachelor of Science degree in engineering, science, or life science. Students with nonengineering backgrounds may be required to take remedial courses in engineering (e.g. materials science, statics and mechanics, and calculus through differential equations) in addition to their regular bioengineering curriculum, which may be taken either before or after enrollment.

The Department offers a Master of Science and a Doctor of Philosophy degree. The curriculum for the MS degree consists of a core of recommended bioengineering courses supplemented by elective courses that provide the student greater depth in a specific area of interest. Two degree options are offered at the master's degree level: a thesis and a nonthesis option. The thesis option requires a total of 30 credit hours (six of which must be research credits) and the submission and defense of a master's thesis. The nonthesis option requires a minimum of 33 credit hours (six of which must be research credits) followed by the submission and oral presentation of a publishable-quality report on an approved topic. The minimum time necessary to complete the master's degree is normally 16 months, out of which at least one academic semester must be undertaken in residence as a full-time student at Clemson University.

Students interested in obtaining a doctoral degree are encouraged to apply directly to the PhD program from their BS degree program, with the PhD program typically requiring about five years to complete following the BS degree or about four years following the MS degree. The selection of courses for the doctoral degree is flexible and depends on the background and objectives of each candidate. A typical program includes 12 or more credit hours of graduate-level courses beyond the MS degree requirements. Candidates for the PhD degree must provide evidence of their potential success in advanced graduate study. This is demonstrated by passing both the qualifying and comprehensive examinations, which are usually taken after the first year of graduate school. The qualifying examination consists of a detailed written report and an oral presentation on the background and the state-of-the-art concepts and theories pertinent to the student's intended area of doctoral research and an oral examination of the student's understanding of these topics. The comprehensive examination involves the oral presentation and defense of the student's proposed original research plan before his/her selected research committee and is typically taken within a year of passing the qualification exam. The PhD program culminates with the presentation and successful defense of a doctoral dissertation, which is scheduled following the completion of the student's approved research plan.

Combined BS/MS Plans

The Department of Bioengineering offers a combined BS/MS plan. Under the plan, students may reduce the time necessary to earn both a BS degree in Bioengineering, Biological Sciences, or Biosystems Engineering and an MS in Bioengineering by applying graduate credits to both undergraduate and graduate program requirements.

Students are encouraged to obtain the specific requirements for the dual degree from the undergraduate department or the Department of Bioengineering as early as possible in their undergraduate programs to ensure that all prerequisite and other program requirements are met. Enrollment guidelines and procedures can be found in the *Undergraduate Announcements*.

BIOSYSTEMS ENGINEERING

Master of Science

Doctor of Philosophy

The Biosystems Engineering program, jointly administered with the College of Agriculture, Forestry, and Life Sciences, prepares individuals for leadership, creative accomplishment, continued professional learning, and independent research.

Students may be accepted with backgrounds in any branch of engineering or quantitative-based scientific fields relating to chemistry, mathematics, physics, or biology. Undergraduate prerequisite or corequisite courses may be required for applicants with undergraduate degrees in nonengineering disciplines.

Acceptance is determined by departmental faculty review based on records of academic achievements (including grades from previous programs and GRE scores) and other appropriate professional accomplishments. Additional information is available at www.clemson.edu/agbioeng/bio/.

Each degree program is planned individually to augment the student's previous engineering and science background with adequate breadth in engineering and specialization in an area of biosystems engineering. Coursework includes biosystems and related engineering, mathematics, physics, chemistry, statistics, and biological, environmental, and engineering sciences.

Candidates for the MS degree are required to complete a minimum of 24 credit hour of coursework plus an additional six hours of thesis research and complete an acceptable thesis.

Candidates for the PhD degree are required to complete additional hours of coursework beyond the MS degree at the discretion of the graduate committee, typically 30–36 additional credits. Completion of 18 hours of dissertation research and the submission of an acceptable dissertation are also required.

Combined BS/MS in Biosystems Engineering

Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. Students are encouraged to obtain the specific requirements for the dual degree from the Department of Biosystems Engineering as early as possible in their undergraduate program. Enrollment guidelines and procedures can be found in the *Undergraduate Announcements*.

CHEMICAL ENGINEERING

Master of Science

Doctor of Philosophy

The Department of Chemical and Biomolecular Engineering offers programs leading to the Doctor of Philosophy and the Master of Science degrees. Graduate programs at Clemson prepare students to apply science and engineering principles to complex problems associated with the chemical, biomolecular, and associated industries. Students develop a rigorous fundamental science base coupled with insight into engineering applications. Graduates can become involved in the research, manufacture, and use of chemicals, polymers, pharmaceuticals, electronic components, consumer products, and petroleum products. The department has a particular focus on research in polymers, catalysis, and biotechnology.

Although most graduate students have a BS in Chemical Engineering, students with backgrounds in chemistry, physics, or other branches of engineering are encouraged to apply and will be fully considered for admission. To facilitate a transition from BS degrees other than Chemical Engineering, special programs are available.

The MS degree program consists of 30 credit hours including six credit hours of research. Coursework includes CHE 803, 804, and 805. In addition, six hours of approved chemical engineering electives and nine hours of approved technical electives are required. At least six of these 12 elective hours must be selected from courses numbered 800 or above. MS degree candidates must complete a thesis.

The PhD program consists of 36 credit hours of approved graduate courses beyond the BS degree including 12 credit hours of approved graduate courses at Clemson. Doctoral students must satisfy the MS course requirements through courses taken at Clemson University or elsewhere. Each doctoral student must complete at least six credit hours of approved graduate courses offered by departments other than Chemical Engineering. In addition, each student is required to complete 30 credit hours of graduate research including 18 doctoral dissertation research credit hours (CHE 991) taken at Clemson University. These requirements establish minimum coursework and research credit requirements and usually are exceeded at the advice of the individual student's advisory committee.

Minors for doctoral students may be taken in chemistry, physics, mathematics, life sciences, or other branches of engineering.

CHEMISTRY

Master of Science

Doctor of Philosophy

Degree concentrations are offered in analytical, inorganic, organic, physical chemistry, and chemistry education. Research areas also include bio-organic chemistry, polymer chemistry, materials chemistry, chemical physics, and other areas. A PhD degree in Chemistry with a concentration in textile chemistry is offered jointly with the School of Materials Science and Engineering.

MS degree candidates must complete 24 hours of coursework and six hours of research culminating in a satisfactory thesis. PhD degree candidates who have not previously been awarded an MS degree in chemistry must complete a regimen of coursework that is at least equivalent to that which would be required to earn an MS degree.

The primary requirement for the PhD degree is the performance of original research leading to a dissertation. PhD degree candidates must qualify to pursue the degree by completing a core of four courses with at least a B average during the first two years of study. The core courses are taken in four areas: one each in organic, physical, analytical, and inorganic chemistry. Qualification requirements may also be satisfied by examination.

Admission to candidacy for the PhD degree requires completion of either a cumulative or a comprehensive examination in the area of concentration. The examination, the type of which depends upon the area selected by the student, may be followed by an oral presentation before a faculty committee.

CIVIL ENGINEERING

Master of Science

Doctor of Philosophy

The Department of Civil Engineering offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees. Within these degrees, there are six primary emphasis areas: Applied Fluid Mechanics, Construction Materials, Geotechnical Engineering, Project Management, Structural Engineering, and Transportation Systems.

Master of Science

The Master of Science degree program is open to all individuals who have a four-year baccalaureate degree. A degree in engineering is not required for admission, but most entering students have an undergraduate Civil Engineering degree.

There are two options available for students pursuing a Master of Science degree. The student may prepare a research thesis or may take additional courses in lieu of completing a thesis.

The thesis option requires the preparation of a research thesis that is a part of the total credit hours required for the degree. Students intending to pursue a doctoral degree usually choose the thesis option. Completion of a research thesis is excellent preparation for the research necessary for a doctorate if a student is inclined to pursue that degree in the future.

The nonthesis option does not require the preparation of a research thesis but does require completion of additional coursework. This degree option provides the student with additional directed study through coursework. Normally students pursuing the nonthesis option will not pursue a doctorate.

Except for the core courses required by different disciplines, there are no formal course requirements for students pursuing a Master of Science degree. The program normally contains some engineering design and a minimum of ten credits of engineering science, advanced mathematics, and basic science. In addition, each student in the thesis option must complete an advanced research project. All students pursuing an MS degree must satisfactorily complete C E 895. The final program of study must contain at least 30 hours of graduate credit including the core curriculum requirements. Of these 30 credits, no more than six hours may be thesis research (C E 891) for those students pursuing the thesis option. At least half of the remaining hours must be from courses numbered 800 or above.

The final examination for the MS nonthesis option is an oral or written exam (or a combination of the two) consisting of questions related to fundamental knowledge in a student's chosen area of concentration (i.e., applied fluid mechanics, construction materials, geotechnical engineering, project management, structural engineering, or transportation systems).

The final examination for the MS thesis option is an oral exam consisting of a student's MS thesis defense and questions related to fundamental knowledge in a student's chosen area of concentration (i.e. applied fluid mechanics, construction materials, geotechnical engineering, project management, structural engineering, or transportation systems).

Doctor of Philosophy

The Doctor of Philosophy degree program is open to all individuals who have a baccalaureate degree and preferably a Master's degree in engineering. Except for the core courses required by different disciplines, there are no formal course requirements for students pursuing a PhD degree; however, each student must complete 18 hours of dissertation research (C E 991). All students must complete C E 895.

The purpose of the PhD research dissertation is to afford the student the opportunity to participate in independent specialized engineering research that can advance the state of the art. The research is conducted under the direction of a member of the faculty who will normally serve as chair of the student's academic advisory committee. The research should be sufficiently demanding technically so as to demonstrate the student's ability to assimilate knowledge from several subject areas for the advancement of engineering knowledge.

Student Evaluation—During the first two semesters in residence, a PhD student must select a faculty advisor. The faculty advisor may assign the student specific duties outside normal coursework requirements that include, but are not necessarily limited to, preparing research proposals and literature surveys, conducting classroom lectures, formulating computer models, and executing data collection and

analysis. The advisor may, at any time, withdraw as the student's faculty advisor if these assigned duties are not performed consistent with the expectations of the faculty advisor. During this initial two-semester period, an advisor should make a determination as to whether a student is capable of completing the requirements for the PhD degree.

Comprehensive Examination—The PhD comprehensive examination is generally scheduled after all coursework has been completed and the dissertation proposal is ready for approval by the student's graduate committee. The examination, therefore, consists of two parts: (1) a written and/or oral examination by the advisory committee on the student's preparation to complete the proposed research and (2) presentation of the proposed research. The PhD comprehensive examination should be completed within two years of entering the PhD program. The written and/or oral examination may include consideration of graduate coursework, preliminary research, and/or other demonstration of the ability to conduct the proposed research. After passing this examination, the student is officially admitted to candidacy for the PhD degree.

Dissertation Defense—As required by the Graduate School, the candidate for the Doctor of Philosophy degree must pass a final oral examination (dissertation defense). The examination consists of a presentation of the student's doctoral research and an assessment by the committee of the research approach, the significance of the findings, and the contribution to the advancement of civil engineering.

More information about the Department of Civil Engineering is available at www.ce.clemson.edu or by phone at (864) 656-3000.

Combined BS/MS in Civil Engineering

Civil Engineering undergraduates at Clemson may begin a Master of Science degree program while completing the Bachelor of Science degree and use a limited number of courses to satisfy the requirements of both their undergraduate and graduate degrees. The following requirements apply:

1. Undergraduate students must have a minimum cumulative grade-point ratio of 3.4 and must have completed the junior year prior to taking graduate courses. Students are required to maintain this minimum grade-point ratio to continue enrollment in a combined degree program.
2. Graduate Record Examination (GRE) scores are not required to be submitted as part of their Graduate School application; however, applicants are encouraged to submit GRE scores to receive full consideration for graduate fellowships and assistantships upon completion of the BS degree.
3. Up to six semester hours from any 600- or 800-level civil engineering courses may be used to satisfy the requirements of the BS degree. These courses may be counted as technical requirements or electives. Undergraduate students are required to have selected one of their technical requirements from the area of transportation systems, geotechnical engineering, or environmental engineering.

4. Since approval of the graduate program of study is required by the student's graduate advisory committee, students should consult with their academic advisors before selecting courses to be included in the graduate program.

5. Students in a combined degree program are conditionally accepted to the graduate program until completion of the BS degree requirements. Students are not eligible for graduate assistantships until full acceptance is granted.

Students interested in this combined degree program should consult the Civil Engineering Graduate Program Coordinator, the undergraduate advisor, and the Civil Engineering Honors Coordinator (if applicable). Students pursuing an optional emphasis area in their undergraduate degree program may substitute 600-level courses for any 400-level counterpart taken to meet the requirements of an emphasis area. Application for this program should be made by the end of the junior year, but no later than one semester prior to expected BS graduation. Application details are available in the the *Undergraduate Announcements*.

COMPUTER ENGINEERING

Master of Science

Doctor of Philosophy

The Computer Engineering program is a combination of computer software, hardware, systems, and applications. Areas of specialization include computer systems architecture, communication networks, digital signal processing, and intelligent systems. Enrollment is open to graduates in any branch of engineering, computer science, or applied mathematics who have an appropriate engineering and/or science background.

For the MS program, students may write a thesis or follow a nonthesis option. The thesis option requires a total of 30 credit hours including six hours of thesis research. For the nonthesis option, 33 credit hours of coursework must be completed.

The PhD degree requires at least 24 credit hours of graduate coursework beyond the master's degree. Specially qualified candidates with a BS degree may apply for direct entry to the PhD program in any of the above areas. The program of study and hours required beyond the baccalaureate degree are specified by the focus area but must be at least 66 hours including coursework and research credit.

Detailed information is available at www.ecs.clemson.edu/.

COMPUTER SCIENCE

Master of Science

Doctor of Philosophy

To receive full admission to graduate study in computer science, a student must have taken intermediate-level undergraduate computer science, including computer organization and data representation, machine and assembly language programming, data structures, file organization and processing, programming systems, theory of computation, and software methodology; and basic mathematics including calculus, probability and statistics, and discrete mathematics. An applicant with minimal deficiencies may be admitted provisionally, while one with several deficiencies may be required to complete satisfactorily prerequisite work as a postbaccalaureate student prior to admission as a graduate student.

A candidate for the MS degree must satisfactorily complete an approved program of at least 30 graduate hours. Students may elect one of three options to satisfy the degree requirements: the research experience, research paper, or thesis option. These options allow the student to count zero, three, or six hours of research credit respectively toward the 30-hour requirement. Students may take up to six hours of approved courses in areas outside the department.

Although formal course requirements for the PhD degree are minimal, a typical program requires two to four years of study beyond the MS degree. Each candidate is required to pass a comprehensive examination, a dissertation proposal, and a defense of the dissertation.

Combined BS/MS in Computer Science

Computer Science undergraduates may begin a Master of Science degree program while completing the Bachelor of Science degree and use a limited number of courses to satisfy the requirements of both their undergraduate and graduate degrees. The following requirements apply:

1. Undergraduate students must have a minimum cumulative grade-point ratio of 3.4 and must have completed the junior year prior to taking graduate courses. Students are required to maintain this minimum grade-point ratio to continue enrollment in a combined degree program.
2. Graduate Record Examination (GRE) scores are not required to be submitted as part of the Graduate School application; however, applicants are encouraged to submit GRE scores to receive full consideration for graduate fellowships and assistantships upon completion of the BS degree.
3. Students in a combined degree program are conditionally accepted to the graduate program until completion of the BS requirements. Students with this conditional acceptance are not eligible for a graduate assistantship until the conditional acceptance is removed.
4. Up to nine semester hours from any 600- or 800-level computer science courses may be used to satisfy the requirements of the BS degree.

5. Graduate courses taken as an undergraduate may be included in the graduate program of study; however, any 600-level course that has a corresponding required 400-level counterpart in the BS or BA in Computer Science or the BS in Computer Information Systems may not be counted toward the MS degree. Since approval of the graduate program of study is required by the student's graduate advisory committee, students should consult their academic advisors before selecting courses to be included in the graduate program.

Students interested in this combined degree program should discuss it with the Computer Science graduate program coordinator and undergraduate program advisor. Students pursuing Senior Departmental Honors should also meet with the Computer Science Honors Coordinator. Application to this program should be made by the end of the junior year but may be made at any time from the junior year until one semester prior to the expected BS graduation. Application details are available in the *Undergraduate Announcements*.

The Computer Science Faculty envision students enrolled in this combined degree program will typically complete nine hours of graduate credit while completing their BS degree requirements and complete the remaining requirements for the MS degree in one calendar year or less of graduate study.

DIGITAL PRODUCTION ARTS

Master of Fine Arts

The Digital Production Arts program is a professional degree program offered jointly with the College of Architecture, Arts, and Humanities. See page 27 for the complete program.

ELECTRICAL ENGINEERING

Master of Engineering

Master of Science

Doctor of Philosophy

Students in Electrical Engineering may direct their programs toward the fields of communication systems and networks, digital signal processing, intelligent systems, applied electromagnetics, electronics, or power systems.

For the MS program, students may write a thesis or follow a nonthesis option. The thesis option requires a total of 30 credit hours including six hours of thesis research. For the nonthesis option, 33 credit hours of coursework must be completed.

The Master of Engineering is a special degree offered for off-campus students through the University telecampus program. Degree requirements include 24 credit hours of coursework and six hours of credit for an engineering report. Additional information is available from the Office of Off-Campus, Distance, and Continuing Education.

The PhD program requires at least 24 credit hours of graduate coursework beyond the master's degree. Specially qualified candidates with a BS degree

may apply for direct entry to the PhD program in any of the above areas. The program of study and hours required beyond the baccalaureate degree are specified by the focus area, but must be at least 66, including coursework and research credit.

Detailed information on program requirements and application procedures is available at www.cee.clemson.edu/.

ENGINEERING AND SCIENCE EDUCATION

Certificate

The Certificate Program in Engineering and Science Education is directed toward graduate students in the College of Engineering and Science who seek classroom experience in preparation for an academic career in their discipline. The program requires 11 credit hours of coursework as follows: CES 850, 861, 871; and three credits selected from ED 955, ED F 778, 878, 879, ED L 855, PSYCH 810/811, 833.

ENVIRONMENTAL ENGINEERING AND SCIENCE

Master of Engineering

Master of Science

Doctor of Philosophy

Environmental engineering and science is concerned with the characterization and control of environmental pollution. Emphasis is placed on applying the fundamental principles of the basic and engineering sciences through research and design to the solution of environmental problems in natural and engineered systems.

The MEng program builds on an ABET-accredited engineering baccalaureate background, while the MS program builds on a student's previous engineering or science background. Students with a baccalaureate degree in any branch of engineering, as well as chemistry, physics, geology, biology, or related majors with a strong mathematical background may be admitted to the program.

Students may specialize in one of six areas: environmental health physics, environmental process engineering, environmental radiochemistry, environmental and waste management, environmental fate and transport, or environmental chemistry. Research master's degree candidates must complete 24 hours of coursework and six hours of research culminating in the presentation of a satisfactory thesis for MS candidates or a special problem report for MEng candidates. The MS nonthesis option, which requires 30 hours of coursework and three hours of independent study, is available. The coursework for all master's students must include EE&S 802, 843, and 851. A final examination is required of all master's candidates.

The PhD program provides the student with a comprehensive background in the fundamental aspects of environmental engineering and science. The major field of study is generally interdisciplinary in nature, consisting of coursework in several areas of engineering and the basic sciences. Each student's

curriculum and research program is tailored to suit his/her personal and professional goals. Qualifying, comprehensive, and final examinations are required. No foreign language is required.

Combined BS in Biosystems

Engineering/MS, MEng in

Environmental Engineering and Science

Under this plan, students may reduce the time necessary to earn both degrees by applying graduate credits to both undergraduate and graduate program requirements. Students are encouraged to obtain the specific requirements for the dual degree from the Department of Environmental Engineering and Earth Sciences or Biosystems Engineering as early as possible in their undergraduate programs. Enrollment guidelines and procedures can be found the *Undergraduate Announcements*.

ENVIRONMENTAL TOXICOLOGY

Master of Science

Doctor of Philosophy

The Environmental Toxicology program is jointly administered with the College of Agriculture, Forestry, and Life Sciences. See page 21 for the complete program.

HYDROGEOLOGY

Master of Science

The Master of Science in Hydrogeology is an interdisciplinary program that focuses on groundwater geology and subsurface remediation and draws on the expertise of faculty in the Department of Environmental Engineering and Earth Sciences. The curriculum is structured to impart a strong background in field experimentation complemented by laboratory studies and computer modeling.

Candidates for the Master of Science degree in Hydrogeology should have a baccalaureate degree in the geosciences; however, students having strong undergraduate backgrounds in other fields of science or related engineering disciplines may be admitted but will be required to correct deficiencies in their geological education during the first year. Specifically, GEOL 101/103, 205, 302; and 314, 316 (or an equivalent), or 413 are required. Students entering this program should also have a strong mathematics background; normally, two semesters of calculus are required and a third semester is recommended.

The degree requires 24 hours of coursework and six hours of thesis research. Candidates must write a thesis based on original research and defend it in an oral examination. Students may pursue a variety of research projects in hydrogeology and related areas such as environmental geochemistry, geophysics, sedimentology/stratigraphy, and multiphase flow modeling. A special nonthesis option is available for students on leave from industry; it requires 30 hours of coursework and a comprehensive written examination.

All candidates must take at least six core courses from a department-approved list, including a modeling course (GEOL (EE&S) 808 is recommended), a field course (GEOL 875 is recommended), and a minimum of three other 800-level geology courses.

INDUSTRIAL ENGINEERING

Master of Science

Doctor of Philosophy

Industrial engineers design, develop, and improve integrated systems that include people, materials, information, equipment, and energy. In addition to these issues, graduates learn to address communications throughout the organization while completing their specialized education. Focus areas for specialization are human factors/ergonomics and production and service systems. Work at the doctoral level includes independent research, dissemination of findings, and preparation for research and teaching careers.

Students with baccalaureate degrees in engineering, the physical sciences, mathematics, or related majors with a strong mathematical background may be admitted into the program. Entering graduate students are assumed to have competence in calculus, probability and statistics, calculus-based physics, and computing. Students admitted without this background will be required to complete successfully additional courses, some of which may not carry graduate credit.

MS Students may select a thesis or nonthesis option. Students in the thesis option must complete a minimum of 30 hours of graduate coursework including six credits of thesis research. Students in the nonthesis option must complete a minimum of 33 hours of graduate coursework.

The PhD program provides the student with a comprehensive knowledge of the field of industrial engineering and a mastery of the methods of research. A minimum of 48 hours of graduate coursework beyond a baccalaureate degree is required. Since a dissertation is mandatory for all PhD candidates, 18 hours of doctoral research are required. A qualifying examination is required, in addition to examinations required by the Graduate School. Additional information is available at www.ces.clemson.edu/ie/.

Undergraduates Involved in Graduate Programs

Undergraduate students majoring in Industrial Engineering at Clemson may take courses for graduate credit in two ways:

1. Seniors with a minimum cumulative grade-point ratio of 3.0 may apply to take graduate courses while continuing to pursue their bachelor's degrees. If successfully completed, these courses may be eligible to be counted towards a master's degree. Students selecting this option *will not* be allowed to count these courses towards the bachelor's degree. (See Graduate School form GS-6 for details.)
2. Students with a minimum cumulative grade-point ratio of 3.4 may apply to take up to 12 semester hours of courses and have them count toward *both* the bachelor's and master's degrees in Industrial

Engineering. To take advantage of this opportunity, students must have a minimum cumulative grade-point ratio of 3.4, must have completed the junior year, and must have been admitted to the graduate program prior to enrolling in courses. Courses eligible for this program include IE 652, 656, 660, 665, 685, 687, 689, 691, 800, 802, 803, 804, 809, 811, 812, 813, 860, 865, 871, 880, 886, 888, and 893. The Undergraduate Curriculum Committee has preapproved these classes as acceptable technical and free electives in a student's BS program. Determination of whether the classes count towards the master's degree will be made by the student's advisory committee after he/she becomes a full-status graduate student. Students should notify the Graduate Coordinator in writing that they wish to be considered for this program. Enrollment guidelines and procedures can be found in the *Undergraduate Announcements*.

In both programs, the decision whether courses count towards the bachelor's degree is determined by the undergraduate committee and whether they count towards the master's degree is determined by the advisory committee that is formed after the student becomes a full-status graduate student.

Students should consult with their undergraduate advisor, the Graduate Coordinator, and/or the Honors Coordinator before enrolling in graduate courses.

MATERIALS SCIENCE AND ENGINEERING

Master of Science

Doctor of Philosophy

Materials science and engineering is concerned with the production, properties, and microstructure of the solid materials that are often the primary limitation to the advancement of modern technology. Emphasis is placed on applying the fundamental principles that govern the structure of the solid state to produce optimum mechanical, electrical, optical, and other physical properties.

The curriculum provides for specialization in metallurgy, glasses and ceramics, and polymeric materials including electronic materials, biomaterials, polymer and fiber science, textile science, polymer and textile chemistry, and fiber and composite materials.

The Materials Science and Engineering program prepares graduate students to apply science and engineering principles to solve problems related to the scientific understanding, characterization, and development of new technology necessary for the processing and manufacturing of different materials and related products.

Students with a baccalaureate degree in any branch of engineering, as well as chemistry, physics, and biology majors with strong mathematical backgrounds, may be admitted to the program. The program is designed to produce engineers and scientists whose degrees represent specialization coupled with a broad foundation in all materials.

Master's degree candidates must complete 24 credit hours of coursework and six credits of research. Of these 24 credit hours, a maximum of 12 credits may be taken from 600-level courses. Each master's degree student must take MS&E 826 and 827.

The Doctor of Philosophy degree provides students with a comprehensive foundation in materials science and engineering. The major field of study is generally interdisciplinary in nature, consisting of coursework in several areas of engineering and science. Comprehensive and final examinations are required. No foreign language is required, but proficiency in one is recommended.

Students should consult their advisors for course requirements. All MS and PhD students must enroll in MS&E 800 every semester.

MATHEMATICAL SCIENCES

Master of Science

Doctor of Philosophy

Entering students are expected to have courses in linear algebra, differential equations, a computer language, and statistics.

For the master's program, both thesis and nonthesis options are available. The curriculum for both options includes foundation courses (advanced calculus, modern algebra, probability, and discrete computing—courses often taken prior to entering the master's program); a breadth requirement (a course from each of algebra, analysis, computing, operations research, and statistics plus one additional course in operations research or statistics); and a concentration area (six courses selected to define an identifiable specialty area). Every student's program is required to include at least one course, possibly chosen from outside the Department of Mathematical Sciences, that emphasizes mathematical modeling. A minimum of 36 graduate credit hours is required for the master's degree. In addition, students in the nonthesis option are required to complete a one-credit-hour project course.

Together with the Department of Mathematics at Kaiserslautern University in Germany, the department offers an exchange program in mathematical sciences. In this program, one year is spent at the host university so that students can obtain two MS degrees, one from their home university and one from the host university. The degree requirements for the Clemson degree are identical to those for the nonthesis MS option.

Students in the doctoral program are expected to satisfy the master's program requirements prior to receiving their doctorate. Including master's study, a doctoral program must have two courses from each of the major areas of the mathematical sciences (algebra, analysis, computing, operations research, and probability/statistics) and generally consists of 60 credit hours of graduate coursework. Students are admitted to candidacy for the PhD degree upon successful completion of a preliminary examination and the comprehensive examination. The preliminary examination consists of tests in three areas chosen from algebra, analysis, computing, operations research, statistics, and stochastic processes. The comprehensive exam assesses the student's readiness to perform independent research and competence in advanced graduate material. The PhD program must include both a concentration area and a supporting area. Additional information is available at www.math.clemson.edu/.

Mathematical sciences courses at the 700-level are applicable to master's degree programs in the School of Education only.

MECHANICAL ENGINEERING

Master of Science

Doctor of Philosophy

Enrollment in the MS and PhD programs is open to students with degrees in physics, applied mathematics, or any branch of engineering.

Students in the MS degree program may choose the thesis or nonthesis option. Students in the thesis program must complete 30 credit hours of coursework, including six hours of thesis research, and write a thesis. Students in the nonthesis program must complete 33 credit hours of coursework and pass an exit examination. Students in the PhD program must pass a qualifying exam, complete 18 hours of dissertation research, and defend a dissertation.

Programs may be selected with concentrations in mechanical and manufacturing systems design (design, dynamics, vibrations, and control, materials and manufacturing), thermal/fluid sciences (computational fluid dynamics, fluid mechanics, heat transfer, thermodynamics, and energy systems), or engineering mechanics (solid mechanics, composite materials, numerical computation methods, and experimental methods).

PHYSICS

Master of Science

Doctor of Philosophy

Graduate studies in physics and astronomy may be pursued by well-prepared students in the physical and mathematical sciences or engineering. As the basic physical science, physics offers unparalleled intellectual opportunities. Theoretical, experimental, or computer-simulated studies of the physical universe, ranging from the macroscopic studies of cosmology to the microscopic world of quanta, are available.

Students beginning graduate studies in physics and astronomy usually enter the MS program. After two semesters, well-prepared students are ready to begin a research program. This program usually culminates in a thesis, although a nonthesis option is available. For the thesis option, 30 credit hours and a final oral examination on the general area of study and thesis defense are required. In the nonthesis option, 36 credit hours are required, including six credit hours of PHYS 890. A written report must be submitted on the directed studies. A final oral examination on the general area and directed activities completes the requirements for the nonthesis option.

Study for the PhD degree begins with the general qualifying examination. A sufficiently high score on this examination may make it possible for a student to bypass the master's degree. An oral examination on the general research area is given within six months after completion of the written qualifying examination. At least three weeks prior to the convocation at which the student expects to receive the PhD degree, a final oral examination on the dissertation must be completed.

POLYMER AND FIBER SCIENCE

Master of Science

Doctor of Philosophy

The MS degree program in Polymer and Fiber Science requires previous undergraduate study in chemistry, physics, mathematics, polymer or fiber science, or an engineering discipline. Students take advanced courses in fiber science, chemistry, physics, textile structure formation, engineering, computer science, and other appropriate areas of study as determined by their graduate committees. Students may concentrate in polymer and fiber chemistry, textile structure formation, textile science, or polymer science. Areas of study include fiber chemistry, fiber physics, chemistry of dyeing, polymer chemistry and physics, advanced polymer systems for fiber and film applications, smart fibers, and others. This degree is highly multidisciplinary in nature. Applicants usually have a BS degree in one of the base sciences or engineering disciplines, mathematics, computer science, textile science, textile chemistry, life science, or a closely allied field. Students may be accepted into the program with deficiencies in chemistry, physics, and mathematics; but the deficiencies must be remedied with appropriate undergraduate courses within a specified time frame.

MS students normally concentrate in fiber and polymer chemistry or physics, dye chemistry, textile science, textile materials formation science, composite materials, or other area of polymer and fiber science. The minor area of study is usually in chemistry, physics, engineering, computer science, life sciences, or mathematics. Each MS candidate must complete an independent scientific or technical investigation and formally report and defend the methodology, results, and conclusions in a thesis. A minimum of 24 credit hours of coursework and six credit hours of research is required for the MS degree. All MS students must enroll in MS&E 800 every semester.

Students in the PhD program may concentrate in polymer science, natural and/or man-made fibers, conversions of new fibers into structures, polymer chemistry and physics, fiber physics, or coloration science. Students are normally admitted to the PhD program after completing the requirements for a BS or MS degree in a base science, engineering, life science, or textile program. Students in the MS program may petition their graduate committees to change to the PhD program after demonstrating an ability to perform at the required level. PhD students should consult their advisors for program requirements. All students must enroll in MS&E 800 every semester. Courses, tailored to the individual's objectives, are selected by the student and his/her advisory committee. The PhD degree requires completion of comprehensive and final examinations. Each candidate must carry out an independent, original scientific investigation and formally report and defend the methodology, results, and conclusions in a dissertation.

COLLEGE OF HEALTH, EDUCATION, AND HUMAN DEVELOPMENT

The College of Health, Education, and Human Development offers advanced degrees in Administration and Supervision; Counselor Education; Curriculum and Instruction; Early Childhood Education; Educational Leadership; Elementary Education; Healthcare Genetics; Human Resource Development; Middle Grades Education; Nursing; Parks, Recreation, and Tourism Management; Reading; Secondary Education; Special Education; and Youth Development Leadership.

The PhD degree is offered in Curriculum and Instruction; Educational Leadership; Healthcare Genetics; and Parks, Recreation, and Tourism Management. The MS degree is offered in Nursing; Parks, Recreation, and Tourism Management; and Youth Development Leadership. The College also offers professional degree programs leading to the Master of Arts in Teaching; Master of Education; Master of Human Resource Development; Master of Parks, Recreation, and Tourism Management; and Specialist in Education degrees. The College of Health, Education, and Human Development and the College of Agriculture, Forestry, and Life Sciences cooperatively offer a Master of Agricultural Education program.

The graduate programs focus on preparing students for leadership positions in educational, healthcare, governmental, and business organizations. Clinical and field experiences are common in many graduate programs. Often programs join with local, state, and federal agencies to provide real-world experiences and research projects for faculty and students. Some programs and courses are offered off campus and in the evening to accommodate the schedules of public schools, higher education, health-care institutions, businesses, and other organizations.

The College of Health, Education, and Human Development offers graduate courses in education and nursing at various off-campus locations across the state. Off-campus course schedules for fall, spring, and summer offerings for school personnel, school districts, and other South Carolina agencies are published by the Office of Off-Campus, Distance, and Continuing Education. In addition, courses are taught by contract with local school districts in the Clemson University service region. Courses are offered in athletic leadership and health to provide electives for students in other areas.

EUGENE T. MOORE SCHOOL OF EDUCATION

The mission of the Eugene T. Moore School of Education is to prepare caring and capable professionals through intellectually engaging experiences in theory, method, and research that connect them to the communities in which they live and serve.

The School of Education trains teachers, counselors, and leaders for P–12 schools, prepares counselors for community practice and higher education institutions, and prepares training and development specialists for business and industry.

The School of Education embraces its conceptual framework of providing caring, capable, and connected professionals for the 21st century. These professionals utilize the knowledge of curriculum, technology, assessment, and instructional/leadership/counseling strategies to effect learning for diverse populations. Clemson University provides resources for courses and clinical experiences in method, research, and content knowledge which enable professionals to be reflective practitioners. Such practitioners are knowledgeable, ethical, caring decision makers responding to local, state, and world needs.

Clemson University is accredited by the National Council for the Accreditation of Teacher Education (NCATE) and the State of South Carolina for the preparation of educational personnel in South Carolina in Early Childhood Education; Elementary Education; Reading; Special Education; Secondary Education programs in agriculture, English, the sciences, mathematics, modern languages, social studies, and technology education; as well as Counselor Education, Curriculum and Instruction, and Educational Leadership. The programs in Counselor Education are accredited by the Council for Accreditation of Counseling and Related Educational Programs (CACREP).

In addition, there is a graduate-level program in Human Resource Development which prepares competent professionals for a variety of education, training, and development settings within industrial, business, and public sector environments.

The Eugene T. Moore School of Education has designated a series of courses to meet the growing demand for continual professional development in the state. ED 735 is used for recertification and nondegree purposes.

ADMINISTRATION AND SUPERVISION

Master of Education Specialist in Education

Master of Education

The Master of Education degree in Administration and Supervision prepares individuals as elementary or secondary school administrators or supervisors. The program provides both a theoretical and field-based foundation in educational leadership with a focus on leading instructional improvement for the benefit of all P–12 students.

Admission Requirements

For admission, individuals must have a baccalaureate degree from a regionally-accredited institution and a minimum of one year of teaching experience. Complete application package should include (1) on-line application, (2) official transcripts from previous institutions (cumulative minimum undergraduate grade-point ratio of 2.70 on the last 60 hours), (3) two recommendations—one from immediate, prior supervisor, (4) current résumé, (5) copy of teaching certificate, and (6) GRE score report of verbal, quantitative, and writing assessments. (Acceptable GRE scores are considered holistically with the student's background and potential success in graduate school.)

Applicants whose native language is not English must also submit TOEFL scores.

If requested by the program coordinator, an interview may be required prior to an admission decision.

Prospective students are encouraged to apply two months prior to the beginning of the term in which they wish to enroll.

Students who anticipate applying to a degree program may not exceed 12 credit hours without program coordinator approval, and enrollment is restricted to the following courses: ED L 700, 715, 730, 735. Nondegree students should consult an advisor before enrolling in any course.

Program Requirements

This program incorporates the academic requirements for certification as a principal and supervisor in South Carolina. Thirty-six hours of graduate credit are required.

Students must complete the following core courses: ED L 710, 720, 725, 730, 745; 750 or 755; 751 or 756. In addition, five courses must be selected from ED F 778, ED L 700, 705, 715, 735, 740, 795.

Specialist in Education

The Education Specialist degree in Administration and Supervision prepares students as senior-level school administrators. The program provides the academic requirements for certification as a superintendent in South Carolina. Additionally, it fulfills the certification requirements of states which specify the completion of a nationally accredited two-year program of graduate study leading to certification as a school administrator.

Admission Requirements

For admission, individuals must have a master's degree from a regionally-accredited institution. Students must also be certified as principals or anticipate certification prior to degree candidacy (final 21 hours of the program).

Complete application package should include (1) on-line application, (2) official undergraduate and graduate transcripts (cumulative minimum grade-point ratio of 3.25 on graduate work), (3) two recommendations—one from immediate, prior supervisor, (4) current résumé, (5) copy of teaching/administration certificate, and (6) GRE score report of verbal, quantitative, and writing assessments. (Acceptable GRE scores are considered holistically with the student's background and potential success in graduate school.)

Applicants whose native language is not English must also submit TOEFL scores.

If requested by the program coordinator, an interview may be required prior to an admission decision.

Prospective students are encouraged to apply two months prior to the beginning of the term in which they wish to enroll.

Program Requirements

Students must complete the following core courses in sequence within three levels:

Level I—ED L 805, 820, 850

Level II—ED L 810 or 950, and 815

Level III—ED L 830, 839, 840, 851

COUNSELOR EDUCATION

Master of Education

The Master in Education in Counselor Education, a CACREP-accredited program, prepares students in one of the following specialty areas: community counseling, school counseling, or student affairs. Graduate education in the Counselor Education program helps students realize their potential as practicing counselors and higher education administrators, engage in professional relationships, and develop a set of meaningful professional values. To this end, the program reflects current knowledge from lay and professional groups concerning current and projected counseling and human development needs of a pluralistic society. Cultural considerations are emphasized so that the experiences provided will be rewarding and useful in today's ever-changing society.

The faculty of the Counselor Education program is dedicated to educating and training counselor education professionals to function in culturally diverse settings. This program utilizes an "integrative practitioner training" model emphasizing development, prevention, and enhancement. The programs are designed to provide a challenging, yet supportive, environment that promotes professional orientation, practice, commitment to inquiry, and self-awareness.

Clemson University recognizes laboratory settings and field-based experiences as providing the student with a realistic perspective on the field; an integrating experience for knowledge and skills acquired in the classroom; a situation that maximizes self-

awareness, self-direction, and self-evaluation; and feedback on his/her progress and development.

Clemson University acknowledges the importance of close supervision in practica or internship placements as a means of maximizing student training and preventing inadvertent harm to clients. Practica and internships are designed so that the focus and intensity of supervision will change as students acquire competent beginning, intermediate, and advanced skills. The University and site supervisors provide each supervisee with periodic performance and evaluation feedback throughout the supervised experience. At no point is any student to engage in any field-based practica experience without the permission of the major advisor.

Practica require 100 hours and internships 600 hours of on-site counseling and/or administrative activities, a minimum of one hour of individual supervision per week, a formal log of all activities, and regular meetings with the student's University and site supervisors.

Each student is assigned a major advisor chosen from the Counselor Education faculty. Students are required to meet with their advisor at least once a semester to ensure appropriate course sequencing.

Upon completion of 33 hours, the student may be given permission by his/her major advisor to take the comprehensive examination. It is the student's responsibility to have an approved plan of study on file prior to taking the comprehensive examination and to make sure that his/her name is on the list to take the comprehensive examination.

Admission Requirements

Applicants must have an undergraduate grade-point ratio of 3.0 on a 4.0 scale (last 60 hours of undergraduate coursework). Complete application package should include on-line application, GRE scores, personal statement, two letters of recommendation, and approval of the Counselor Education faculty. Applications for summer and fall admission are due by March 1; for spring admission, October 1. Applications will be reviewed only twice a year.

The Community Counseling Emphasis also requires a minimum of 12 credit hours of psychology and/or sociology, graduate or undergraduate.

Program Objectives—The student will develop respect for the dignity and worth of the individual; develop commitment to the fulfillment of human potential; understand educational and counseling processes; gain knowledge in his/her particular field of counseling; develop competence in the application of professional expertise in counseling; gain knowledge of the role and function of professionals in related fields; develop a commitment to inquiry; and develop maturity in self-development.

Additional information is available at www.hehd.clemson.edu/schoolofed/graduate.htm.

Testing Requirements

Students in all Counselor Education programs take written comprehensive examinations, which are graded on a pass/fail basis. Passing this examination is required for the degree. With the advisor's permission, students are eligible to take the comprehensive examination. At least two committee members must pass the student. If a student does

not pass the written comprehensive examination, the major advisor may recommend a second written or oral examination. This recommendation may be during the same semester or in the following one. If the student fails the written examination twice, he/she will be removed from the program.

Community Counseling Emphasis

Students with an emphasis in Community Counseling will demonstrate an ability to work effectively with community and other agency personnel; an ability to meet qualifications for certification or licensure; understanding and skills related to counseling needs in the environment in which they choose to work; a high degree of self-understanding; an ability to communicate effectively with diverse cultural groups; a knowledge about counseling across the lifespan; human evaluation and research skills; a high degree of sensitivity and acceptance of others' behavior; an awareness of responsibilities specific to a variety of community agencies; and ethical practices. Additional information is available at www.hehd.clemson.edu/schoolofed/.

The Community Counseling Emphasis requires 51 credit hours arranged as follows:

Area of Specialization—42 credit hours: ED C 805, 810, 811, 812, 813, 814, 815, 816, 818, 821, 822, 823, ED F 701, 778

Field Experiences—nine credit hours of ED C 836, 846. Students must complete 21 credit hours before participating in internship.

School Counseling Emphasis

Students with an emphasis in School Counseling will demonstrate an ability to work effectively with students, teachers, administrators, and other members of the community as well as a high level of expertise in counseling appraisal, theory, skills, and intervention techniques.

Qualification for state and national certification as school counselors includes an ability to conduct a comprehensive and developmental school guidance and counseling program; a healthy self-awareness and understanding; counseling within the framework of their respective association's legal and ethical standards; ability to counsel with sensitivity, caring, and an appropriate approach in diverse environments; and ability to perform in a consultative capacity both within and outside of the school environment. Additional information is available at www.hehd.clemson.edu/schoolofed/.

The School Counseling Emphasis requires 51 credit hours, arranged as follows:

Foundations—six credits: ED F 701, 778

Area of Specialization—36 credits: ED C 801, 807, 810, 811, 812, 813, 814, 815, 816, 818, 821, 822

Field Experiences—nine credits: ED C 830, 841

Testing Requirements

In addition to successful completion of the written comprehensive examination, students must pass the PRAXIS II Subject Assessment test in School Guidance and Counseling. The score must be reported to Clemson and must be recorded in the students file before certification verification will be sent to any State Department of Education.

Student Affairs Emphasis (Student Affairs Practice—

Administration, College Counseling)

Students with an emphasis in Student Affairs will demonstrate the ability to work effectively with faculty, students, administrators, and other members of the academic community; preparation for employment in higher education settings in a variety of roles; the ability to act as consultants throughout the higher education setting; understanding and skills related to counseling and developmental needs at the postsecondary level; a high degree of self-understanding; the ability to communicate effectively with all cultural groups; a high degree of sensitivity and acceptance of diversity in thought and action; an awareness of the responsibilities of student affairs practitioners to the developmental needs and maintenance of quality experiences for students, faculty members, administrators, and staff; and ethical practice.

The Student Affairs Emphasis requires 48 credit hours arranged as follows:

Core Courses—27 credit hours: ED C 803, 804, 810, 811, 812, 814, 815, 819, and three elective hours

Field Experiences—nine credit hours: ED C 834, 844

Area of Specialization—12 credit hours as follows:

Student Affairs Practice in Higher Education (Administration)—ED C 806, 809, ED L 765, 855

Student Affairs Counseling—ED C 805, 813, ED F 701, 778

CURRICULUM AND INSTRUCTION

Doctor of Philosophy

The Doctor of Philosophy degree in Curriculum and Instruction is a research degree that prepares students to become scholars who can discover, integrate, and apply knowledge, as well as communicate and disseminate it. The intent of the program is to prepare students to make significant original contributions to knowledge in specialized fields. The program prepares students in one of the following specialty concentrations: elementary education, English education, mathematics education, science education, social studies education, reading education, or special education. These areas provide a general structure of coursework selections and research emphases; however, students are encouraged to work with faculty to design programs uniquely fitted to their areas of interest. The program of study for the degree is determined by the student's advisory committee.

Every doctoral student must satisfy all requirements of the Graduate School as well as requirements in coursework, internships, the comprehensive exam, the dissertation proposal, and oral defense of the dissertation as directed by the student's advisory committee. Students must maintain a B average in all graduate work. The degree usually requires a minimum of 70 credit hours beyond the master's degree, selected from the areas prescribed by the requirements of the PhD in Curriculum and In-

struction. Listed below are the guidelines or normal expectations for a student receiving the PhD degree; however, the final determination of the course of study is made by the advisory committee.

Graduate courses designated for professional development are not eligible to be used toward a graduate degree.

A minimum of three to six hours of internship is required as part of each specialty area. An internship of sufficient time and quality of experiences to warrant three to six semester hours of graduate credit must be planned and executed to the satisfaction of the student's advisory committee.

Specialty areas require 6–18 credits in courses outside the School of Education. This approved coursework is intended to provide a concentration within the specialty area and/or exposure to disciplines outside the School of Education.

Admission Requirements

Complete application package should include proof of a master's degree, official undergraduate and graduate transcripts, GRE scores, a résumé showing relevant professional experiences, and a personal statement of professional history, goals, and aspirations. Candidates passing initial committee review are invited for an interview. Students whose native language is not English must take the Test of English as a Foreign Language (TOEFL). The deadlines for admission consideration are October 15 and March 15.

Core Requirement Goals

The student will be able to critically analyze social, historical, psychological, personal, and policy factors in the development and current practices of curriculum and instruction; acquire an understanding of the research processes including practical design, analysis, and reporting; understand how to use historical, correlational, descriptive, and experimental methods within research; be able to analyze critically and evaluate research reports; and be able to prepare scholarly, research-based reports and presentations.

Course Requirements

The Curriculum and Instruction Program requirements are as follows:

Core Courses—ED 954, 955, ED F 875, 908, and six additional credits selected from ED F 870, 872, ED L (ED F) 800, ED L 950, ED SP 853

Research and Assessment Methodology—13 credits: ED (ED F, ED SP) 894, ED F 878, 879, EX ST 801

Specialty Area—27–30 credit hours, including six hours outside the School of Education. Courses vary according to the area.

Internship—three–six hours: ED (ED F, ED SP) 980

Dissertation—18 hours of ED (ED F, ED SP) 991

Elementary Education Emphasis

Students with an emphasis in Elementary Education will demonstrate (1) a research knowledge base of one or more of the academic areas taught in the elementary school with an understanding of how the different areas relate to the learning and instructional needs of all students, including design,

implementation, and evaluation of curriculum; effective instructional methods; and current issues and trends affecting teaching and/or learning and (2) competence in basic and applied research and evaluation related to the elementary school, such as curriculum, instruction, and ancillary programs.

The Elementary Education Emphasis Area requires ED (ED F, ED SP) 980, ED EL 937, 938, plus 21 additional credit hours approved by the doctoral committee. A three-hour internship is required.

Reading Education Emphasis

Students with an emphasis in Reading will demonstrate (1) a research knowledge base in the field of reading with an understanding of the relationship to the learning and instructional needs of all students, including design, implementation, and evaluation of curriculum; effective instructional methods; and current issues and trends affecting teaching and/or learning and (2) competence in basic and applied research and evaluation related to the field of reading, such as curriculum, instruction, assessment, and ancillary programs.

The Reading Education Emphasis Area requires PSYCH 833, READ 939, 944, plus 12 additional credit hours selected from READ 884, 885, 886, 887, 937, 938, 940, 941, 942, 943, 945. A six-hour internship is also required.

Secondary Education Emphasis

The PhD program in Curriculum and Instruction with an emphasis in English Language, Mathematics, Natural Sciences, or Social Studies has five possible professional market niches. The student's program for each niche will contain appropriate study in both that subject area and that niche to provide the necessary skills to be a productive professional. These five niches are in English language, mathematics, science, or social studies teacher educator in higher education; a subject-specific curriculum coordinator or curriculum supervisor in a medium to large school district, state department of education, or federal government agency; a teacher of English language, mathematics, science, or social studies in a small four-year or community/technical college; a curriculum developer of secondary English, mathematics, science, or social studies or; an educator of programs in English language, mathematics, science, or social studies in commerce and industry.

English Education Goals—Students with an emphasis in Secondary Education–English will demonstrate a research knowledge base that includes current research in the areas of teaching composition, literary response, language development, developments in English language, and multimedia applications for the English classroom. This will occur within a literary canon that celebrates diversity and competence in basic and applied research and evaluation related to English education.

Mathematics Education Goals—The emphasis area in Mathematics Education will provide students with instruction and understanding in the mathematics curriculum—what is taught, the process of instruction, how mathematics is taught and assessed, and the mathematical knowledge of the teacher—so that students may fulfill a variety of professional responsibilities. In addition, students will acquire

the skills necessary to read, interpret, utilize, and conduct research in mathematics education in order to expand the research knowledge base and allow students to apply knowledge to specific professional responsibilities.

Science Education Goals—Students with an emphasis in Science Education will demonstrate an understanding of the science education research knowledge base; a knowledge of how science process and content are most effectively learned; familiarity with the components of state-of-the-art curriculum models which are most conducive to learning; and the ability to use the most effective research methodologies designed to expand the theory base.

Social Studies Education Goals—Students with an emphasis in Social Studies Education will develop a knowledge base in current social studies issues, research, and classroom applications and an ability to select and pursue appropriate research topics in social studies.

The Secondary Education Emphasis requires 30 credit hours arranged as follows:

Concentration—18 credit hours of advanced coursework in a discipline or related areas

Internship—three to six credit hours

Advanced studies in the teaching of English, mathematics, science, or social studies—three hours from the appropriate area: EDSEC 841, 842, 843, or 844

Current Literature in Education—three hours from the appropriate area: EDSEC 846, 847, 848, or 849

Special Education Emphasis

Students with an emphasis in Special Education will demonstrate knowledge and skills in special education research and teaching. Students will demonstrate mastery of content in special education and competence in basic and applied research in special education using appropriate research methodology.

The Special Education Emphasis requires ED (ED F, ED SP) 980, ED SP 853, 930, 934, 935, and 12 credit hours of elective coursework that may include ED 901, 938, ED SP 936, 937.

EARLY CHILDHOOD EDUCATION

Master of Education

The Master of Education degree program in Early Childhood Education (birth to age eight, with an emphasis on preschool through third grade) provides a research-based master's degree program that strengthens the math, science, and technology knowledge base and skills of early childhood teachers at the state, national, and international levels. Furthermore, this master's degree program offers a thesis track, which will increase the number of professionals in the field of early childhood education who are prepared to continue graduate work, complete the terminal degree, and provide research and teaching contributions within South Carolina and the nation. There is currently a shortage of doctoral-level professionals in early childhood education, and an important goal of this program

is to provide a research-based master's program that will encourage further graduate work.

Admissions Requirements

Students applying to the Master's degree program in Early Childhood Education will submit the following information. From this information and, in some cases, an interview, an admissions committee will admit the most qualified cohort of students each year:

1. Application form
2. Personal letter of application
3. Transcript showing bachelor's degree and grade-point ratio
4. Valid teaching certificate in early childhood education, elementary education, or a related field (in which case students may be required to take prerequisite or leveling coursework)
5. Graduate Record Exam (GRE) scores
6. Two letters of recommendation from professionals

Program Requirements

Following are required courses for the Master's Degree in Early Childhood Education. The degree has two tracks: Track I is the thesis option, and Track II is the applied option. Both tracks require 24 hours of core courses, which include courses in early childhood and math/science/technology emphasis courses.

Track I requires research methods courses and a six-hour thesis for a total of 36 hours. Track II requires 18 hours of applied coursework in addition to the 24-credit-hour core for a total of 42 hours. Courses for both tracks are listed below.

The following courses are required of students in both options: ED EC 800, 840, 850, 890, 895, ED SP 760, READ 870. In addition, students in the Thesis Option must take MTHSC 715; students in the Applied Option must take ED F 778 or 879 for a total of 24 credit hours of core courses.

Track I: Thesis Option

In addition to the core courses outlined above, students in the Thesis Option must complete the following courses: ED F 778, 879, and ED EC 885 (taken twice) for a total of 36 semester hours.

Track II: Applied Option

In addition to the core courses outlined above, students in the Applied Option must take six credit hours selected from ED EL 826, 892, ED F 697, ED SP 822 plus 12 additional credits selected from the following: ED EC 810, 820, 880, ED F 701, 702, 870, READ 865, 871, 873 for a total of 42 semester hours.

EDUCATIONAL LEADERSHIP

Doctor of Philosophy

The PhD program in Educational Leadership provides students with a strong background in five domains: leadership, research, policy, ethics, and diversity. As the highest academic degree granted by Clemson University, the PhD prepares students to become scholars who can discover, integrate, and apply knowledge as leaders in schools and post-secondary and community educational institutions and agencies. This is accomplished through close association with and apprenticeship to faculty members experienced in research, teaching, and administration.

Admission Requirements

Complete application package should include GRE scores, earned master's degree, official bachelor's and master's transcripts, three letters of recommendation, and a two-page letter discussing reasons for pursuing the PhD degree. This letter will be evaluated as a writing sample. At the discretion of the selection committee, an interview may be conducted.

Program Requirements

A student admitted to the Educational Leadership program must begin coursework within one year from the semester of acceptance or reapply for admission. Two concentrations—P12 and Higher Education—are offered for candidates pursuing the PhD in Educational Leadership. All candidates must take a minimum of 58 credit hours of graduate-level courses beyond the master's degree and complete an 18-hour dissertation project. The program core consists of a minimum of nine credits completed within the first two years of enrollment culminating in the Preliminary Exam. Upon successful completion of Preliminary Exam, students consult with their Doctoral Advisory Committees establishing their program of studies, including courses in concentration, research, internships, and cognates. Internships are supervised by a practicing educational leader and by a faculty member. The internship experience is designed to acquaint the student with the practical applications of education theory in a planned, extensive, and closely monitored opportunity for the student to work in a setting which reflects the student's long-range goals and the requirements for rigorous applied research. Cognates are courses from academic fields supporting the student's research agenda. Upon completion of program of studies coursework, students qualify as doctoral candidates by successfully completing a comprehensive exam. The culminating requirement for the program is successful completion of the dissertation as guided by the Major Advisor and the Doctoral Advising Committee.

Course Requirements

Preliminary Core Courses—The following credits are required before taking the preliminary exam: ED L 900, 905, 910, plus a research course.

Concentration—A minimum of 18 credit hours, selected with the advice of the Doctoral Advisory Committee, is required.

Research—Students must complete a qualitative research course (e.g., ED F 879), an intermediate and advanced research course (e.g., ED F 878, EX ST

801), and a series of directed research core courses (ED L 988, 989, and 990).

Cognates – Cognates include courses from another area of study. As a part of the program of study, each student must complete six graduate credit hours in a field outside education. All six hours must be from the same discipline and approved by the student's Doctoral Advising Committee.

Dissertation—A minimum of 18 credit hours (ED L 991) is required for the dissertation.

Internship—All students are required to complete six hours of field research internship credit (ED L 985 and 986).

Distance Education Options

The PhD program in Educational Leadership offers distance education options for both the P12 and the Higher Education Concentrations. In both cases, all requirements remain the same as for the on-campus degree programs, and all courses are enrollment-dependent.

ELEMENTARY EDUCATION

Master of Education

The Master of Education in Elementary Education includes coursework in psychological and sociological foundations, curriculum development, pedagogy, specialized content, and research. The program is intended to strengthen and enhance teaching skills, promote research and reflection on innovative teaching strategies, and expand content knowledge. By examining and reflecting on best practices, students have the opportunity to improve the qualities that make them effective teachers who respond to the emotional, motivational, cognitive, and cultural needs of all students. The use of multiple teaching strategies, lively class discussion, and active student involvement supports learning for all students.

Admission Requirements

A complete application package should include a bachelor's degree, a valid teaching certificate, two letters of recommendation, an undergraduate transcript with a grade-point ratio of 3.0 on a 4.0 scale (last 60 hours), and GRE scores.

Before enrolling in any graduate course, the student should arrange a conference with the major advisor. Courses taken prior to this conference may not be acceptable for the degree. Professional development courses will not count toward the degree. Exceptions to the program of study must be approved by the student's advisory committee consisting of the major advisor and two faculty members from the department in which the student has taken coursework.

Degree Requirements

Graduate students must satisfy requirements for the Graduate School, complete the approved program of study for the degree, maintain a B average in all graduate work, and pass a comprehensive exam. The degree requires 36 credit hours.

When the student has successfully completed 27 credit hours toward the degree, he/she may take the comprehensive examination. The examination will be written and arranged at a specified time each semester.

Psychological and Sociological Foundations—Six credit hours selected from ED L 715 or (ED F) 800; ED F 701 or 702

Curriculum Development—ED EL 760, 804

Specialized Content—ED SP 823, READ 865

Research—ED F 778, 808

Option—Twelve credit hours as follows:

Elementary Option—Six to nine credit hours of coursework related to the specific content/subject matter taught in the elementary school; and three to six credit hours of coursework related to classroom practices, teaching methods, and instructional techniques

Mathematics and Science Option—12 credit hours of coursework related to specific mathematics and science content taught in the elementary school

Language Arts Option—12 credit hours of coursework related to specific language arts content taught in the elementary school

HUMAN RESOURCE DEVELOPMENT

Master of Human Resource Development

The human resource field is a specialized blend of education, systems design, consulting, psychology, management, and sociology. The Master of Human Resource Development (MHRD) degree prepares professionals to work as trainers/instructional designers, human performance improvement (HPI) specialists, and consultants within business, industry, non-profit, and government organizations.

HRD/HPI professionals commonly provide diagnostic and intervention strategies related to the areas of technical and interpersonal skills, management, human and organizational performance, and motivation. The MHRD program involves and enhances human performance in the workplace. The program is designed for professionals with three or more years of experience and is delivered in an interactive online format. The curriculum consists of 12 courses delivered over a two-year period in a cohort setting. Graduates of the program are capable of utilizing contemporary instructional and human performance technologies and methodologies. Program participants gain valuable skills and knowledge that accelerate their careers.

Admission Requirements

Applicants to the MHRD program follow general admission procedures as prescribed by the Graduate School. *Note:* The deadline to apply to the MHRD program is July 1. Every required item in support of the application must be on file by that date. The complete application package should include the following: baccalaureate degree with a preferred minimum grade-point ratio of 3.0, transcript, résumé, letter describing professional goals, two letters of reference, and GRE scores. Applicants must possess three years of relevant full-time work experience and complete the on-line Keirsey™ Temperament Sorter®-II and Campbell™ Interest and Skill Survey®. These assessments are available

at www.keirseycampbell.com/. (Click on *Purchase Here*. Use the promotion code CLEMS0323 to have scores for both assessments sent to the MHRD admissions committee. A nominal fee is charged for these assessments.)

Program Requirements

All courses are delivered through distance education technologies. Students need access to e-mail and the Internet and the ability to read a CD-ROM or DVD. Students also need current versions of operating systems, word processing, spreadsheet, and presentation software. Since the required courses involve sending and receiving large files of information, students will need a computer equipped with a Web cam, microphone, and DSL or high-speed internet connection.

The MHRD program consists of 36 credit hours of coursework arranged as follows:

First Year

Fall Semester

3 - H R D 820 Human Performance Improvement
3 - H R D 830 Concepts of Human Resource Dev.
6

Spring Semester

3 - H R D (CTE) 847 Instructional Syst. Design
3 - H R D 880 Research Concepts and Skills
6

Summer

3 - H R D (CTE) 870 Consulting for Education and Industry
3 - H R D 890 Instrumentation for Human Performance Improvement
6

Second Year

Fall Semester

3 - H R D (CTE) 845 Needs Assessment for Education and Industry
3 - H R D (CTE) 860 Instructional Materials Development
6

Spring Semester

3 - H R D 849 Evaluation of Training and Development/HRD Programs
3 - H R D 897 Appl. Research and Development
6

Summer

3 - H R D 825 Organizational Performance Improvement
3 - H R D 882 Knowledge Management for Improved Performance
6

36 Total Semester Hours

Students must satisfy requirements for the Graduate School, complete the approved program of study for the degree, maintain a B average in all graduate coursework, and pass a comprehensive exam.

MIDDLE GRADES EDUCATION

Master of Arts in Teaching

The Master of Arts in Teaching degree is designed for mid-career professionals who are seeking to change fields and for students with backgrounds in content areas who are not currently certified to teach. The program in Middle Grades Education possesses several intrinsic advantages over other initial certification programs. Most importantly, it places well-prepared candidates in the classroom in a timely manner. An individual possessing a bachelor's degree in a content or closely related field is given an intensive one-year, field-based experience. He/she can then expect to start in the classroom as a first year teacher after a full academic year (including summer sessions).

The objectives of the Master of Arts in Teaching in Middle Grades Education are to promote the entrance of content-ready individuals into the South Carolina classroom in a timely manner and to provide a rigorous yet plausible route for individuals seeking to change careers and enter teaching.

Admission Requirements

Acceptance is based on a combination of test scores, interviews, and academic record. Applicants are expected to take the Praxis II exams in the two content areas in which they plan to receive certification. They are required to have passed one of these Praxis II exams to be admitted to the program.

Program Requirements

The MAT program, offered at the University Center of Greenville, is composed of three elements: core pedagogical coursework, content coursework, and an intensive field-based component. Core courses are taken by cohort students in a block—two during first summer session, three in the fall, and three in the spring. This includes six hours of Methods Practicum, three in each area of content certification. These six credit hours meet the State's requirements for student teaching. The remaining 12 credit hours are taken individually in the content areas.

Students in the MAT block begin during the fall semester when public schools begin. They spend the full day in the schools.

In the spring, students begin the semester with two weeks of intensive classroom work in the three remaining core courses. These courses are considered "bookend" classes that bracket the student teaching experience. The methods practicum/student teaching includes a portfolio assignment.

The MAT in Middle Grades Education program requires 36 credit hours, arranged as follows:

Summer Session I Block Courses—ED F 702, 703

Summer Session II Block Courses—content courses at the master's level approved by advisor

Fall Semester Block Courses—ED 641, ED F 808, and one three-hour methods course

Spring Semester Block Courses—ED SP 823, READ 867, and one three-hour methods course

Content Area Courses—12 credit hours scheduled by the student and advisor

READING

Master of Education

The purpose of the MEd degree in Reading is to educate reading professionals who have an in-depth knowledge of reading theories, processes, strategies, curriculum, and research and who can use that knowledge to plan appropriate reading programs and curricula for a variety of contexts and communicate information to a wide variety of audiences.

Objectives

Graduates with the MEd in Reading will demonstrate (1) an understanding of reading as the process of constructing meaning through the interaction of the reader's existing knowledge, the information suggested by the written language, and the context of the reading situation; (2) knowledge of the influence of cultural, ethnic, and linguistic backgrounds on the reading process and how to use what the reader brings to the reading experience; (3) an understanding of relationships among the language processes of reading, writing, listening, and speaking; (4) support for students in acquiring the ability to monitor comprehension and reading processes and apply appropriate strategies for a variety of purposes; knowledge of assessments that involve multiple indicators of learner progress; (5) development of an environment that motivates students to pursue and respond to reading and writing for personal growth and development; (6) understanding of English language learners' literacy and language development and expertise in supporting their literacy learning through strategic teaching; (7) classroom-based research in reading; and (8) expertise in sharing knowledge of reading research and instructional practices with peers.

Admission Requirements

Complete application package should include a completed application, statement of purpose (professional goals and philosophy or teaching), a valid teaching certificate, two letters of recommendation, an undergraduate transcript with a grade-point ratio of 3.0 on a 4.0 scale (last 60 hours), and competitive GRE scores.

Program Requirements

The program requires 36 credit hours of coursework and a satisfactory score on the comprehensive exam. The following courses are required of all students: ED F 702, 808, READ 860 (prerequisite for ESOL Emphasis), 861, 862, 863, 864, 865, 866.

The MEd in Reading offers five plans for completion of course requirements:

Reading Teacher and Reading Consultant Certifications—In addition to the required core courses above, students must take nine additional credit hours of reading/language arts courses selected from ED F 880, ED SP 820, ENGL 700, READ 867, 868, 869, 870, 871, 872, 873, 882, 883.

Reading Teacher and Reading Consultant Certifications plus Reading Recovery Training—(Three years teaching experience are recommended as training prerequisite.) In addition to the required courses above, students are required to take READ 880, 881, and three additional credit hours selected from ED F 880, ED SP 820, ENGL 700, READ 867, 868, 869, 870, 871, 872, 873, 882, 883.

Reading Teacher, Reading Consultant, and Reading Coordinator/Director Certifications—In addition to the required courses above, students are required to take nine credit hours arranged as follows: three hours selected from ED C 801, 811, 812; three hours selected from ED EL 760, EDSEC 765; three hours selected from ED L 705, 720, 730, 735.

Early Literacy Emphasis with Reading Teacher and Reading Consultant Certifications—In addition to the required courses above, students are required to take nine additional credit hours selected from READ 870, 871, 872, 873.

English Speakers of Other Languages with Reading Teacher and Reading Consultant Certifications and ESOL Certification Support—In addition to the required courses above, students are required to take ED 839, ED SP 823, READ 870, 874.

SECONDARY EDUCATION

Master of Education

The purpose of the MEd degree in Secondary Education is to assist secondary teachers in increasing competence in both subject content and instruction; therefore, the program has practical and theoretical work in education as well as appropriate content in the subject area.

The student's advisor depends upon the content specialty area: English language, mathematics, natural sciences, and social studies. Before enrolling in any graduate course, the student shall arrange a conference with the major advisor. Courses taken prior to this conference may not be acceptable for the degree. The advisory committee will consist of the major advisor, a faculty member chosen from the appropriate content teaching area department from whom the student has taken coursework, and a third member at-large (typically one from whom courses are taken). When the student has successfully completed the examination, the committee will recommend that the degree be granted. The examination will be written and arranged at a specified time each semester.

Admission Requirements

A complete application package should include a completed application, a valid teaching certificate, two letters of recommendation, an undergraduate transcript with a grade-point ratio of 3.0 on a 4.0 scale (last 60 hours), and competitive GRE scores.

Degree Requirements

The Secondary Education program requires a minimum of 36 credit hours in graduate courses with a grade-point ratio 3.0 or higher, of which at least 18 hours must be from courses at the 700-level or above.

Specific course requirements follow:

Education Courses—15–18 credit hours: ED 860, ED F 778, 808, EDSEC 765, 803, READ 864. (Students who have successfully completed an undergraduate content reading course are not required to take READ 864.)

Content Courses—A minimum of 18 hours of content courses at the 600, 700, or 800 level, approved by the advisory committee, will be completed in English, mathematics, natural sciences, or social

studies. Students must complete EDSEC 841, 842, 843, or 844. Students in mathematics must also complete EDSEC 637 unless a similar undergraduate course was completed. Appropriate courses in emphasis areas include the following:

English—composition, literature, drama, theatre, communication studies, visual arts, technical writing, graphic communications

Mathematics—mathematics, experimental statistics, computer science

Natural Sciences—astronomy, biological sciences, botany, chemistry, crop and soil environmental science, entomology, environmental sciences, genetics, geology, microbiology, physics, and selected courses in animal and veterinary sciences, food science, health science, horticulture, plant pathology, wildlife and fisheries biology

Social Studies—cultural studies, economics, geography, history, political science, psychology, sociology

Electives—To complete the 36 credit hours required, students may enroll in an approved elective. Recommended electives include ED F (AG ED, CTE) 680, (AG ED, CTE) 682, 690, 701, 702, 870, 872, ED L (ED F) 800. The advisory committee may approve electives not listed above.

SPECIAL EDUCATION

Master of Education

The Master of Education degree in Special Education ensures that students are knowledgeable in the field of special education. The program in Special Education prepares students in one of the following areas: emotional/behavioral disorders, learning disabilities, or mental retardation. The program is approved by the Council for Exceptional Children (CEC) and follows guidelines prescribed by CEC. The prescribed program of study enables students to identify important legal and policy issues in special education, demonstrate knowledge of the research processes within the field of special education, demonstrate knowledge of specific characteristics of individuals with mild disabilities, and implement research-validated interventions for students with disabilities in a variety of settings. Successful graduates will evaluate critically the literature in the field, recognize and evaluate current issues and problems in special education, and identify potential solutions for these problems.

Graduate students must satisfy requirements of the Graduate School, complete the approved program of study for the degree, maintain a B average in all graduate work, and pass a comprehensive exam. The degree requires 36 credit hours.

Admission Requirements

A complete application package should include a bachelor's degree, a valid teaching certificate, two letters of recommendation, an undergraduate transcript with a grade-point ratio of 3.0 on a 4.0 scale (last 60 hours), and acceptable GRE scores.

Program Requirements

Required Courses—ED F 778, ED SP 820, 821, 822, 823, 841, 853, 854

Area of Emphasis—9–12 credit hours

Students choose from one of the emphasis areas below. Courses in each area partially fulfill requirements for South Carolina certification in that area.

Emotional/Behavioral Disabilities Disorders—ED SP 669, 674, 675*, 678

Learning Disabilities—ED SP 670, 675*, 676

Mental Retardation—ED SP 672, 673, 679

Electives—Three credit hours are required. READ 865 is recommended for those intending to work in elementary settings. ED SP 840 is recommended for those intending to work in secondary settings.

*ED SP 675 is required for South Carolina certification in Emotional/Behavioral Disabilities and should be included in the program of study in lieu of elective hours unless it has been taken previously.

YOUTH DEVELOPMENT LEADERSHIP

Master of Science

The Master of Science degree program in Youth Development Leadership equips students with the competencies, knowledge, and skills to help young people develop into healthy, competent, coping, and contributing citizens. This program prepares students to address issues facing youth in the context of family and community with an emphasis on positive outcomes through a dynamic learning environment.

The MS in Youth Development Leadership program is an interdisciplinary degree primarily involving departments and units in the College of Health, Education, and Human Development but also including academic areas from other colleges and units at the University. This program is designed to meet the needs of students who are also working professionals. All courses are offered in an accelerated format and are delivered through a variety of asynchronous and synchronous distance education technologies. Minimum technology requirements for this program include access to e-mail and the Internet with the ability to read CD-ROMs and DVDs.

This program has a strong relationship with youth-related agencies/organizations and engages them in learning and experiential opportunities for students. The Youth Development Leadership program is designed to empower students to focus on strengths and assets within the context of family and community that will promote positive youth development; identify and examine physical, emotional, environmental, and social issues related to being a young person in today's society; prepare professional educators and leaders at all program and management levels for careers in schools, agencies, institutions, and community groups that serve youth; train new and current professionals to be well prepared with increased knowledge and enhanced skills in the youth development area; prepare leaders who will have an immediate impact on youth development in South Carolina and around the nation; link formal and non-formal prevention and intervention youth programs to enhance the learning experience for students; and enhance youth serving agencies

and organizations by supplying professionals who are competent in child and adolescent growth and development.

The Master of Science in Youth Development Leadership requires 36 semester hours of coursework as follows: EX ST 801, HEHD 800, 801, 802, 803, 804, 805, 806, 807, 808, 892, SOC 805.

Admission Requirements

A complete application package should include proof of a baccalaureate degree with a minimum grade-point ratio of 3.0 on a 4.0 scale, an acceptable score on the Graduate Record Examination (GRE), a letter of intent, and two letters of reference. Experience in the field of youth development is preferred.

HEALTHCARE GENETICS

Doctor of Philosophy

The interdisciplinary Doctor of Philosophy degree program in Healthcare Genetics, provided through the School of Nursing, offers individuals from multiple health-related disciplines the opportunity to achieve a terminal degree in Healthcare Genetics. The curriculum builds partnerships with more than six disciplines focusing on genetics, health policy and ethics, theory development, and quantitative and qualitative research methods. Three specialty research tracks promote advanced study in Translational Genetics [Bench Research], Applied Population Genetics as an Interventionist, or Genetics in Ethics/Health Policy.

The PhD program in Healthcare Genetics prepares interdisciplinary scientists to extend the knowledge base relevant to healthcare genomics, translate research to advance the application of genomics in healthcare, and collaborate in interdisciplinary research and practice.

Objectives of the program are as follows:

1. Collaborate with other disciplines to generate knowledge and develop theories that focus on the genetic aspects of actual and potential health problems of diverse individuals, families, groups, and communities while addressing health disparities.
2. Formulate health promotion, disease prevention, and treatment strategies that translate and integrate genomic knowledge from a variety of disciplines.
3. Demonstrate leadership that facilitates interdisciplinary development and application of ethical guidelines and health policy in genetics.
4. Disseminate research findings to develop healthcare models that incorporate the expanding knowledge of genetics.

Coursework includes a variety of on-line, web-enhanced, and traditional classroom settings. Core courses are available on the Clemson University campus as well as a variety of other institutions.

Admission Requirements

Students applying for the Healthcare Genetics program will have at least a bachelor's degree in a related health science discipline from an accredited institution. Other requirements include the following:

1. GRE scores equivalent to the current scores of 500 for verbal and quantitative sections and 4.0 for the analytical writing section
2. Master's (MS/MA) thesis or publications (BS applicants entering without a data-based research experience will be required to complete satisfactorily a research project utilizing the six hours of cognate electives prior to beginning the core courses in the doctoral program.)
3. Submission of a curriculum vita
4. Written statement of career goals
5. Graduate School application with three letters of recommendation from professionals which address research and scholarly potential
6. Interviews with two faculty members (may be conducted in person, Polycom, or telephone depending on individual circumstances)
7. Cumulative grade-point ratio of 3.4 or higher in the undergraduate (and/or graduate programs if applicable)

The curriculum is composed of 12 core courses and three cognate specialties/tracks. The core curriculum provides 34 hours of coursework in the areas of genetics, health policy and ethics, theory development, and quantitative and qualitative research methods. In the specialty cognates, students pursue advanced study in Basic Genetics [Bench Research], Applied Population Genetics as an Interventionist, or Genetics in Ethics/Health Policy. Seminars and electives bring the cognate hours to 18. With 18 hours of dissertation (requirements met as manuscripts submitted for preparation), the total credit hours required is 70. This can be accomplished full-time over a four-year period.

The coordinator of the PhD program in Healthcare Genetics, in concert with individual faculty advisors, will work with each student to determine the requirements for their program of study. The plan of study for a student entering with a bachelor's degree will be developed that reflects prior coursework, required prerequisites, and data-based research experiences. Students without previous biochemistry courses will be required to take BIOCH 632 or its equivalent.

Comprehensive exams and 18 hours of dissertation research are required (to be developed as a manuscript for publication).

NURSING

Master of Science

The Master of Science degree program with a major in Nursing builds upon the first professional degree. The student acquires knowledge and skills in advanced nursing: clinical nurse specialist (CNS), nurse practitioner (NP), nurse administration, or nursing education. The student may select one of the following study options: child/adolescent nursing (CNS), adult/gerontological nursing (CNS), adult/gerontological nurse practitioner (ANP), family nurse practitioner (FNP), gerontological nurse practitioner (GNP), nurse administration, or nursing education. All graduate options articulate with the baccalaureate program in the continued acquisition of advanced nursing knowledge and

skills. This specialization builds toward advanced nursing knowledge in selected practice and role areas. Theory, research, and role development are emphasized to enable graduates to participate in the development of nursing knowledge and contribute to the advancement of the nursing profession.

The objectives of the Master of Science degree program in Nursing are to provide graduates with the ability to integrate advanced knowledge from nursing and related disciplines into a specialized area of nursing practice; demonstrate competence in a selected functional role (clinical specialist, nurse practitioner, nurse administrator, or nurse educator); evaluate and apply research findings from nursing and related disciplines to advanced nursing practice; participate in the development of nursing knowledge by identifying researchable nursing problems, conducting research, and selectively integrating research findings in advanced nursing practice; utilize leadership, management, teaching knowledge, and competence to influence nursing practice; participate as a leader to influence health policy and improve the health care delivery system; and contribute to the advancement of the nursing profession.

All graduate courses are based at the University Center of Greenville.

Admission Requirements

In addition to meeting University admission requirements, applicants should be graduates of nationally-accredited baccalaureate nursing programs; must have had an undergraduate statistics course, computer course, or equivalent; and must demonstrate evidence of current basic client assessment skills. In addition, students must document recent significant nursing practice which is defined as 600 hours during the 12 months prior to acceptance into the program. Nursing Administration majors must complete an undergraduate accounting course.

PARKS, RECREATION, AND TOURISM MANAGEMENT

Master of Parks, Recreation, and Tourism Management

Master of Science

Doctor of Philosophy

The Department of Parks, Recreation, and Tourism Management offers a professional master's degree (MPRTM), a Master of Science degree (MS), and a Doctor of Philosophy degree (PhD). Flexibility permits individual development in professional interest areas such as therapeutic recreation, travel and tourism management, recreation resource management and interpretation, and community recreation management. Each student's program is tailored to suit his/her personal and professional goals. Applicants from nonrecreation disciplines are required to develop background knowledge of recreation through undergraduate coursework. MS and PhD applicants must submit GRE scores.

The Master of Parks, Recreation, and Tourism Management should be selected by individuals who intend to enter or reenter the workplace upon completion of degree requirements. Applicants for

the MPRTM degree must document at least three years of full-time relevant professional experience beyond a bachelor's degree in recreation and a 3.0 undergraduate grade-point ratio. Each candidate completes an independent project to meet degree requirements. A minimum of 36 hours of coursework is required.

The Master of Science degree requires a thesis. This degree is designed for individuals planning to undertake doctoral study or seek employment in a research-related position or for those without three years of relevant professional experience. Candidates must complete a minimum of 30 hours of coursework and six hours of research culminating in a thesis.

The Doctor of Philosophy is an advanced research degree requiring performance of original research leading to a dissertation. Comprehensive and final examinations and 18 hours of dissertation research are required. Coursework is determined by each student's doctoral committee.

COURSES OF INSTRUCTION

This list includes for each course the catalog number, title, credit hours, class and laboratory hours per week, description, and prerequisites.

A secondary listing in parentheses indicates that this course is cross-listed with another program.

Graduate credit may be earned only for courses numbered 600 or above. Each 600-level course carries a 400-level undergraduate counterpart. Students who receive graduate credit in such courses must do extra work of an appropriate nature as determined by the department and are graded according to graduate standards. Students who receive credit for the 400-level course may not receive credit later for the same course at the 600 level.

Courses at the 700 level are designed primarily for the degrees that emphasize professional practice rather than research.

COURSE ABBREVIATIONS

Accounting	ACCT
Aerospace Studies	A S
Agricultural Education	AG ED
Agricultural Mechanization	AG M
Agriculture	AGRIC
Agriculture, Forestry, and Life Sciences	AFLS
American Sign Language	A S L
Animal and Veterinary Sciences	AVS
Animal Physiology	AN PH
Anthropology	ANTH
Applied Economics	AP EC
Architecture	ARCH
Art	ART
Art and Architectural History	A A H
Astronomy	ASTR
Athletic Leadership	A L
Automotive Engineering	AU E
Biochemistry	BIOCH
Bioengineering	BIO E
Biological Sciences	BIOSC
Biology	BIOL
Biomolecular Engineering	BMOLE
Biosystems Engineering	B E
Botany	BOT
Business	BUS
Business Administration	M B A
Calhoun Honors Seminar	C H S
Career and Technology Education	CTE
Ceramic and Materials Engineering	C M E
Chemical Engineering	CH E
Chemistry	CH
Chinese	CHIN
City and Regional Planning	C R P
Civil Engineering	C E
Clemson University	C U
College of Engineering and Science	CES
Communication Studies	COMM
Community and Rural Development	C R D
Computer Science	CP SC
Construction Science and Management	C S M
Crop and Soil Environmental Science	CSENV
Dance	DANCE
Design Studies	DSIGN
Early Childhood Education	ED EC

East Asian Studies	E A S
Economics	ECON
Education	ED
Educational Counseling	ED C
Educational Foundations	ED F
Educational Leadership	ED L
Electrical and Computer Engineering	E C E
Elementary Education	ED EL
Engineering	ENGR
Engineering Graphics	E G
Engineering Mechanics	E M
English	ENGL
Entomology	ENT
Environmental and Natural Resources	E N R
Environmental Design and Planning	EDP
Environmental Engineering and Science	EE&S
Environmental Science and Policy	EN SP
Environmental Toxicology	ENTOX
Executive Leadership and Entrepreneurship	E L E
Experimental Statistics	EX ST
Family and Community Studies	FCS
Finance	FIN
Food Science	FD SC
Food Technology	FD TH
Forest and Recreation Resources	F&RR
Forestry	FOR
French	FR
Genetics	GEN
Geography	GEOG
Geology	GEO
German	GER
Graduate Studies	G S
Graphic Communications	G C
Great Works	G W
Health	HLTH
Health Administration	M H A
Health, Education, and Human Development	HEHD
Healthcare Genetics	HGEN
Historic Preservation	H P
History	HIST
Horticulture	HORT
Human Resource Development	H R D
Humanities	HUM
Industrial Engineering	I E
Integrated Pest Management	I P M
Italian	ITAL
Japanese	JAPN
Landscape Architecture	LARCH
Language	LANG
Language and International Trade	L&IT
Latin	LATIN
Law	LAW
Leisure Skills	L S
Library	LIB
Management	MGT
Marketing	MKT
Materials Science and Engineering	MS&E
Mathematical Sciences	MTHSC
Mechanical Engineering	M E
Microbiology	MICRO
Military Leadership	M L
Music	MUSIC
Nonprofit Leadership	NPL
Nursing	NURS
Nutrition	NUTR
Packaging Science	PKGSC
Pan African Studies	P A S

Parks, Recreation, and Tourism Management	PRTM
Performing Arts	P A
Philosophy	PHIL
Physical Science	PH SC
Physics	PHYS
Plant and Environmental Sciences	PES
Plant Pathology	PL PA
Plant Physiology	PL PH
Policy Studies	PO ST
Political Science	PO SC
Polymer and Fiber Chemistry	PFC
Portuguese	PORT
Psychology	PSYCH
Public Administration	P ADM
Reading	READ
Real Estate Development	RED
Religion	REL
Rhetoric, Communication, and Information Design	RCID
Rural Sociology	R S
Russian	RUSS
Secondary Education	EDSEC
Sociology	SOC
Soils and Sustainable Crop Systems	SSCS
Spanish	SPAN
Special Education	ED SP
Textiles	TEXT
Theatre	THEA
Vocational-Technical Education	VT ED
Wildlife and Fisheries Biology	W F B
Women's Studies	W S

ACCOUNTING

ACCT 604 Individual Taxation 3(3,0) Interpretation of federal income tax laws, regulations, and court decisions with practice in application of these laws to the returns of individuals, partnerships, and corporations. *Prq:* ACCT 311 with a C or better.

ACCT 610 Budgeting and Executive Control 3(3,0) Study and application of selected techniques used in the planning and control functions of business organizations. *Prq:* ACCT 303 with a C or better.

ACCT 821 Controllership 3(3,0) Advanced internal accounting emphasizing accounting implications for management decision making. *Prq:* ACCT 303 or equivalent.

ACCT 851 Tax Research 3(3,0) Tax research methodology as applied to the solution of routine and complex tax problems emphasizing the methodology of solution rather than a specific tax area. *Prq:* ACCT 404 or equivalent.

ACCT 852 Financial Accounting Theory and Research 3(3,0) Evolution of financial accounting theory and its application to contemporary reporting. Emphasis is on learning to research, document, and present a rationale for a recommended alternative. Research problems are derived from actual audit disputes concerning financial presentation. *Prq:* ACCT 313 or equivalent.

ACCT 853 Advanced Accounting Problems 3(3,0) Study of specialized aspects of financial reporting including business combinations, fund accounting, and emerging practices and developments in financial accounting. *Prq:* ACCT 313 or equivalent.

- ACCT 854 Ethical, Professional, and Societal Responsibilities 3(3,0)** Study of ethical and societal responsibilities and constraints that define and affect the practice of accountancy. Includes selected readings and cases. *Preq:* ACCT 404 and 415, or equivalent.
- ACCT 856 CPA Exam Review—A 0** Preparation for the auditing and attestation section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/Fail only. *Preq:* Enrollment in MPAcc program.
- ACCT 857 CPA Exam Review—B 0** Preparation for the business environment and concepts section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/Fail only. *Preq:* Enrollment in MPAcc program.
- ACCT 858 CPA Exam Review—F 0** Preparation for the financial accounting and reporting section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. To be taken Pass/Fail only. *Preq:* Enrollment in MPAcc program.
- ACCT 859 CPA Exam Review—R 0** Preparation for the regulation section of the Certified Public Accountant exam. Must be completed prior to receiving MPAcc degree. Does not contribute hours toward degree completion. *Preq:* Enrollment in MPAcc program.
- ACCT 861 Operational Auditing 3(3,0)** Provides in-depth understanding of concepts underlying operational auditing and experience in planning, conducting, and reporting in operational auditing using a risk-based, process and controls focused approach. *Preq:* ACCT 415 or equivalent.
- ACCT 862 Financial Auditing 3(3,0)** Advanced course in financial auditing to provide a framework for thinking about contemporary auditing and assurance issues and evaluating alternative rationales regarding the value and purpose of an audit as well as conducting financial audit research. *Preq:* ACCT 415 or equivalent.
- ACCT 863 Forensics and Analysis 3(3,0)** Study of financial statement analysis with quality assessments and forensic analysis. Includes forecasting, asset and business valuation approaches, and other special topics. *Preq:* ACCT 313 or equivalent.
- ACCT 864 Accounting Information Systems 3(3,0)** Accounting systems including database concepts, systems design and evaluation, systems controls, and systems implementation. *Preq:* ACCT 322 and 415, or equivalent.
- ACCT 865 Taxation of Business Decisions 3(3,0)** Discusses the interrelationship of taxation and business decisions. Designed for students not specializing in taxation. *Preq:* ACCT 404 or equivalent.
- ACCT 871 Federal and State Income Taxation of Corporations 3(3,0)** Discusses tax principles and concepts involved in corporate-shareholder transactions, tax planning of corporations, Subchapter C, and related provisions of the Internal Revenue Code. *Preq:* ACCT 404 or equivalent.
- ACCT 872 Taxation of Flowthrough Entities 3(3,0)** Covers federal income taxation of entities treated as partnerships, S corporations, estates, and trusts. *Preq:* ACCT 404 or equivalent.
- ACCT 873 International and Special Topics in Taxation 3(3,0)** Seminar on international and special topic areas that impact practicing tax professionals. *Preq:* ACCT 404 or equivalent.
- ACCT 874 Tax Aspects of Financial Planning 3(3,0)** Covers federal estate and gift tax laws; federal income tax laws related to trusts and estates. *Preq:* ACCT 404 or equivalent.
- ACCT 875 State, Local, and Advanced Topics in Taxation 3(3,0)** Explores state and local income taxation issues and planning, retirement plans, deferred compensation plans, IRS practice and procedures, and current sophisticated developments in taxation. *Preq:* ACCT 404 or equivalent.

AGRICULTURAL EDUCATION

AG ED 601 Instructional Methods in Agricultural Education 3(2,3) Appropriate methods of teaching vocational agriculture in high schools. Includes procedures for organizing teaching programs, teaching high school students, and directing FFA activities.

AG ED 603 Principles of Adult/Extension Education 3(3,0) Overview of adult/extension education and adult learning. Selection of adult education providers is reviewed with emphasis on extension. *Preq:* Junior standing or consent of instructor.

AG ED 609 Agriscience Institute: Applications of Agriscience to the Secondary Curriculum 3(2,2) Designed for pre-service and in-service agricultural educators or secondary level counselors. Surveys current developments in agriscience with an emphasis on modern practices, current job opportunities, and meeting state and national science and math education standards through agricultural instruction. Students construct lesson plans and career planning modules for high school. *Preq:* AG ED 102.

AG ED 615 Leadership of Volunteers 3(3,0) Provides an overview of volunteer management. Examines the knowledge, skills, and abilities required of professional managers to involve volunteers effectively in the work of organizations.

AG ED 616 Ethics and Issues in Agriculture and the Food and Fiber System 3(3,0) Explores ethical theories, concepts of critical thinking, and major ethical issues in American agriculture. The major social, political, economic, and ethical issues that arise in connection to the "food and fiber system" are examined and potential solutions considered.

AG ED 623 Curriculum 2(2,0) Curriculum goals and related planning for career and continuing education programs.

AG ED 625 Teaching Agricultural Mechanics 2(1,3) Organizing course content, conducting and managing an agricultural mechanics laboratory, shop safety, microteaching demonstrations of psychomotor skills, and methods of teaching manipulative abilities.

AG ED 628 Special Studies in Agricultural Education 1-3(1-3,0) Students study, individually or collectively, selected topics and/or problems in agricultural education to meet the particular needs of the clientele enrolled. May be repeated for a maximum of six credits.

AG ED 640 Program Development in Adult/Extension Education 3(3,0) Principles, theory, and practice in planning and conducting educational programs in adult/extension settings. *Preq:* Junior standing or consent of instructor.

AG ED (CTE, ED F) 680 Educational Applications of Microcomputers 3(2,2) See ED F 680.

AG ED (CTE, ED F) 682 Advanced Educational Applications of Microcomputers 3(2,2) See ED F 682.

AG ED 736 Internship Teaching 3(1,6) Increases professional competency and program development through classroom and practical experiences in planning, conducting, and evaluating educational programs. Offered spring semester only.

AG ED 737 Internship in Agribusiness Firms 3(1,6) Provides classroom and practical experiences in selected agricultural businesses and industries. Students identify and practice entry-level competencies required in selected agribusiness and natural resource management enterprises. Offered summer session only.

AG ED 750 Special Institute Course: Selected Topics in Agricultural Education 1-3(1-3,0) Subject areas organized according to institute needs. Topics vary from course to course. May be repeated for a maximum of nine credits. *Preq:* Consent of instructor.

AG ED 801 Systems for Technology Transfer 3(3,0) Development of a philosophical foundation and utilization of cooperative learning strategies and techniques to disseminate effectively technological change for expanding clientele and diverse socioeconomic environments.

AG ED 804 Special Problems 3(2,3) Planning, conducting, and reporting a special problem in agricultural and vocational education appropriate to students' needs.

AG ED 805 Administration and Supervision in Agricultural Education 3(3,0) Guides students in developing a philosophy of education including application of administrative concepts in supervising agricultural education programs. Offered spring semester of even-numbered years only. *Preq:* Experience in agricultural education.

AG ED 810 Clinical Research in Agricultural Education 1-6(0,3-18) Individual work on an assigned research topic in agricultural education. May be repeated for a maximum of nine credits. *Preq:* AG ED (CTE, ED) 889, EX ST 801.

AG ED 812 Development of Supervised Agricultural Experience Programs 3(3,0) Provides secondary agriculture teachers with strategies for supervising and guiding students' supervised agricultural experiences (SAE). *Preq:* Student teaching in agricultural education.

AG ED 815 Teaching Agricultural and Power Mechanics 3(2,3) Methods of determining course content, organizing teaching modules in logical sequence, equipping shop, teaching agricultural and power mechanics to farm and agribusiness clientele, providing individualized instruction, and developing off-farm experience programs. Offered summer session of odd-numbered years only.

AG ED 821 Theories and Practices of Adult Education 3(3,0) Study of recent research on adult learning. Includes a comparison of the assumptions supporting pedagogy and andragogy and teaching adults through formal classes and community organizations. Offered spring semester only. *Preq:* ED 302 or PSYCH 201 or equivalent.

AG ED 869 Seminar 1-3(1-3,0) Students and faculty review current topics in agricultural education.

AG ED (CTE, ED) 889 Research in Education 3(3,0) Includes problem selection. Investigates types of educational research and techniques employed. Includes the use of ERIC system and computer program packages. Requires interpretation of research findings.

AGRICULTURAL MECHANIZATION

AG M 602 Drainage, Irrigation, and Waste Management 3(2,3) Basic soil-water-plant relationships are used to determine the need for and methods of irrigation, drainage, and waste management. Topics include irrigation methods, drainage needs, drainage methods, and waste-treatment methods.

AG M 605 Agricultural Structures and Environmental Control 3(2,3) Technical considerations of buildings used for agriculture with emphasis on structural materials, structural adequacy, environmental control, and indoor air quality. *Preq:* AG M 221, 303, PHYS 200.

AG M 606 Mechanical and Hydraulic Systems 3(2,3) Study of power transmission systems for agricultural production with emphasis on mobile equipment. Characteristics, requirements, and design of both V-belt drive and roller-chain drives are presented. Emphasizes hydraulic power transmission systems, including pumps, actuators, control devices, and hydraulic circuitry. *Preq:* AG M 206, PHYS 200 or 207, or consent of instructor.

AG M 610 Precision Agriculture Technology 3(2,3) Includes principles and hands-on application of technologies supporting precision agriculture. Topics include Global Positioning System (GPS) and Geographic Information System (GIS) software, variable rate technologies, collection of spatial data, automated guidance of equipment, spatial data mapping and analysis, remote sensing, and economic considerations. *Preq:* Graduate standing.

AG M 652 Mobile Power 3(2,3) Study of tractors with emphasis on internal combustion engines and support systems necessary for their proper functioning; application of power, maintenance, adjustment, and general repair. *Preq:* PHYS 200, 207, or consent of instructor.

AG M 660 Electrical Systems 3(2,3) Students in agriculture and related curricula study electric and other utilities on the farm and in the home. Selection, installation, and maintenance of wiring systems, lighting systems, motors, controls, water systems, and waste disposal systems are emphasized. *Preq:* Junior standing.

AG M 712 Farm Machinery Management 3(2,3) Investigates selection, functional analysis, and maximum utilization of existing and developing farm machinery. Discusses computer applications to programming of field operations, available capital and labor, machine size, critical field operations, growing degree days, weather, and maintenance equipment, procedures, and scheduling.

AG M 771 Selected Topics in Agricultural Mechanization 1-3(1-3,0) Selected topics not covered in other courses. Performance is measured by oral or written reports or examinations. May be repeated for a maximum of six credits.

AG M 781 Special Problems 1-3(1-3,0) Independent analysis through literature review and laboratory or field research. Requires written documentation. May be repeated for a maximum of six credits.

AGRICULTURE

AGRIC 640 Microclimatology 3(3,0) Study of energy balance in the earth's atmosphere and soil: solar and thermal radiation, air and soil temperature, humidity, evaporation and the hydrologic cycle, wind fields. Weather variables to describe microclimates and the energy balance of plants, animals, and insects. Modification of microclimates. Rural and urban climates. *Preq:* PHYS 240 or equivalent or consent of instructor; second semester Junior standing.

ANIMAL AND VETERINARY SCIENCES

AVS 601 Beef Production 4(3,2) Discusses breeding, feeding, reproduction, and management of beef cattle. Emphasizes production systems integrating disciplines of animal agriculture into management plans and alternatives. Practical applications of beef production and management practices are also presented. Offered fall semester only. *Preq:* AVS 202, 370.

AVS 610 Domestic Animal Behavior 3(3,0) Provides knowledge and understanding of behavior related to perception, learning, sociality, reproduction, feeding, and health for application in production, training, and design of environments for optimum health and welfare of domestic animals. *Preq:* AVS 150, 151.

AVS 611 Animal Growth and Development 3(3,0) Integration of the nutritional, physiological, and genetic basis for animal growth and development with application to livestock and poultry production. Includes the cellular and molecular mechanisms controlling these processes and emphasizes the genes that regulate animal products (meat, eggs, wool, and milk). *Preq:* AVS 301.

AVS 612 Advanced Equine Management 4(3,2) Further discussion of special considerations of the equine regarding housing, manure management, nutrition, reproduction, transportation, and behavior. Students gain insight into how horses differ from other livestock species and their unique requirements for the above systems. *Preq:* AVS 370.

AVS (BIOSC, MICRO) 614 Basic Immunology 4(3,3) See MICRO 614.

AVS 615 Contemporary Issues in Animal Science 3(3,0) Provides knowledge, understanding, and critical analytical skills on current issues in animal agriculture in diverse regional, national, and global social-cultural and political environments as they impact animals and man. *Preq:* Junior standing in Animal and Veterinary Sciences.

AVS 618 Muscle Biology and Lean Meats 3(2,2) Biology of animal muscle, connective, fat, and bone tissue with laboratory emphasis on low-fat sausages and restructured, value-added meat products. *Preq:* AVS 202.

AVS 620 Poultry Science On-line 3(3,0) On-line course covering the physiology, nutrition, health, reproduction, genetics, breeding, housing, and management of commercial poultry species including the processing of meat and egg products.

AVS 643 AVS International Experience 1-3(1-3,0) Preplanned and approved international education/cultural experience supervised by an Animal and Veterinary Sciences faculty member. Periodic reports or record keeping are required. Final report and oral presentation are required at the end of the experience. May be repeated for a maximum of four credits. To be taken Pass/Fail only. *Preq:* Consent of instructor.

AVS 653 Animal Reproduction 3(2,2) Reproductive physiology and endocrinology of mammals with emphasis on farm animals and frequent reference to reproduction in laboratory animals and humans. *Preq:* AVS 150, 301.

AVS 655 Animal Reproductive Management 1(0,3) Physiology and endocrinology of pregnant and nonpregnant cows are discussed. Emphasis is on methods of artificial insemination, pregnancy detection, and computer record keeping for achieving a high level of reproductive efficiency in cattle. *Preq:* AVS 150, 301; AVS 453 (or concurrent enrollment).

AVS 670 Animal Genetics 3(3,0) Fundamental principles relating to the breeding and improvement of livestock including variation, heredity, selection, linebreeding, inbreeding, crossbreeding, and other related subjects. *Preq:* AVS 150.

AVS (BIOSC) 680 Vertebrate Endocrinology 3(3,0) See BIOSC 680.

AVS 801 Selected Topics 1-3(1-3,0) Current topics of special interest in animal, dairy, or veterinary sciences not covered in other courses. May be repeated for credit. *Preq:* Consent of coordinating instructor.

AVS 802 Meat Technology 3(3,0) Biochemistry, histology, and microbiology of fresh, frozen, cured, smoked, and processed meats; quality of meats and meat products; processing methods; nutritive value; research techniques. *Preq:* AVS 353.

AVS 803 Physiology of Reproduction and Milk Secretion 3(3,0) Advanced concepts of steroidogenesis, gametogenesis, fertilization, placentation, embryogenesis, embryonic-endometrial relationships, parturition, and lactation and the influence of hormones on these processes. Students evaluate the most recent scientific literature in these areas for information, experimental methods, and validity of authors' conclusions and select a problem, review related literature, and write a research proposal for solving the problem. *Prq:* AVS 453 and 461 or consent of instructor.

AVS 804 Methods in Animal Breeding 3(3,0) Gene and zygotic frequency, system of mating, heritabilities, genetic consequences of selection, and criteria for evaluating improvement in all domestic livestock. *Prq:* AVS 652.

AVS 808 Industrial Dairy and Meat Science 3(1,6) Managerial training for operating food plants with particular emphasis on regulations, policy, and decision making for dairy plants and meat plants. *Prq:* Consent of instructor.

AVS 820 Animal and Veterinary Sciences Graduate Seminar 1(1,0) Ongoing research, evaluation of research needs, research techniques, critical reviews, and discussions of published research in all areas of the animal, dairy, and veterinary sciences.

AVS 822 Special Problems 1-3(0,3-9) Laboratory, library, or field study of problems related to animal, dairy, and veterinary sciences emphasizing development and testing of hypotheses and reporting of results. May be repeated for a maximum of four credits. *Prq:* Consent of instructor supervising study.

AVS 825 Immunobiology 3(3,0) Conceptual approach to immunobiology emphasizing the molecular and cellular aspects. Classical and current literature is the major source for the discussion/lecture format. Offered spring semester only. *Prq:* Consent of instructor.

AVS 891 Master's Thesis Research 1-12

AVS 991 Doctoral Dissertation Research 1-12

ANIMAL PHYSIOLOGY

AN PH 802 Selected Topics 1-3(1-3,0) Current topics of special interest in animal physiology not covered in other courses. May be repeated for a maximum of six credits. *Prq:* Consent of instructor.

AN PH 806 Care and Use of Research Animals 3(1,6) Demonstration and practice of humane use and care of animals in research. Considers pain, analgesia, and anesthesia; regulatory aspects of the use of animals in teaching and research; and surgical techniques and sample collection. Offered fall semester only. *Prq:* BIOSC 659 or consent of instructor.

AN PH 807 Special Problems in Animal Physiology 1-3(1-3,0) Research not related to a thesis. May include a comprehensive review of related literature.

AN PH 812 Digestive-Metabolic, Excretory, and Respiratory Physiology 5(4,3) Advanced concepts of mechanisms and functions of the gastrointestinal tract (mastication, salivation, digestion, absorption, metabolism, excretion), kidney (anatomy, filtration, secretion, reabsorption), and respiratory systems (transport, exchange, and utilization of gases); the action of the nervous system, hormones, and pharmacologic agents on these organ systems. Offered fall semester of even-numbered years only. *Prq:* BIOSC 659 or consent of course coordinator.

AN PH 851 Animal Physiology Seminar 1(1,0) Current research and development in animal physiology through related literature and student and faculty participation. May be repeated for a maximum of two credit hours.

AN PH 891 Master's Thesis Research 1-12

ANTHROPOLOGY

ANTH 603 Qualitative Methods 3(3,0) Methods and techniques of qualitative field research including participant observation, ethnographic interviewing, data analysis, and report writing. *Prq:* ANTH 201 or consent of instructor.

APPLIED ECONOMICS

APEC 602 Production Economics 3(3,0) Economic analysis of agricultural production involving the concept of the farm as a firm, principles for decision making, the quantitative nature and use of production and cost functions and their interrelations, and application of these principles to resource allocation in farms and among areas. Offered fall semester only. *Prq:* AP EC 308, ECON 314.

AP EC 603 Land Economics 3(3,0) Study of the characteristics of land and of the physical, legal, social, and economic principles and problems relating to the control and use of land resources. Offered spring semester only. *Prq:* AP EC 202 or ECON 200.

AP EC 609 Commodity Futures Markets 3(3,0) Introduction to the economic theory, organization, and operating principles of agricultural commodity futures markets in the United States. Emphasis is placed on speculating, hedging, and investing in agricultural commodity futures contracts from the standpoint of the agribusiness entrepreneur. *Prq:* AP EC 202 or ECON 211.

AP EC (C R D) 611 Regional Impact Analysis 3(3,0) See C R D 611.

AP EC (C R D) 612 Regional Economic Development Theory and Policy 3(3,0) See C R D 612.

AP EC 613 Advanced Real Estate Appraisal 3(3,0) Topics include highest and best use analysis, data collection and analyses. Advanced appraisal procedures for income, cost, and comparable sales approach to real estate valuation are stressed. Eminent domain, the appraisal of property in transition, and specialized property are covered. Offered spring semester only. *Prq:* AP EC 313, FIN 307, or consent of instructor.

AP EC 620 World Agricultural Trade 3(3,0) Review of practical considerations of agricultural trade and trade policy analysis. Considers the role of international institutions. Special emphasis is placed on concepts of agricultural trade, analysis of trade policies of major trading partners/competitors, and export/import marketing of products. Offered spring semester only. *Prq:* AP EC 309, ECON 412, or consent of instructor.

AP EC 621 Globalization 3(3,0) Utilizes basic principles of international economics (comparative advantage, free trade vs. protectionism, exchange rate determination, etc.) to analyze the contemporary problems and issues of the world economy. Emphasizes application of economic principles to current globalization trends. *Prq:* ECON 310 or 412 or 413 or consent of instructor.

AP EC (CSENV) 626 Cropping Systems Analysis 3(2,2) See CSENV 626.

AP EC 633 Agricultural Law and Related Environmental Issues 3(3,0) Introduction to agricultural and agricultural-related environmental legal issues. Topics include a review of laws, agencies, programs, court structure, torts, taxation, biotechnology, land and water use, regulated industry, and environment liabilities as they relate to agriculture and natural resources. Offered spring semester only. *Prq:* LAW 322 or consent of instructor.

AP EC 652 Agricultural Policy 3(3,0) Review of public agricultural policy programs in the United States and a critical examination of current and proposed government policies and programs affecting the agricultural sector of the economy. Includes economic considerations as related to past and current farm price and income problems. Offered spring semester only. *Prq:* AP EC 302, 309.

AP EC 656 Prices 3(3,0) Review of the basic theory of price under competitive conditions and various modifications; nature, measurement, and causes of daily, seasonal, and cyclical price fluctuations; geographical price relationships; nature, function, and behavior of futures markets; government price programs. Offered spring semester only. *Prq:* AP EC 308, ECON 314, EX ST 462.

AP EC 657 Natural Resource Economic Theory and Policy 3(3,0) Focuses on analysis of actual, efficient, and sustainable use of natural resources. Topics may vary but include land-use change and regulation, water use and marketing, harvesting trees or fish on farms, harvesting and developing property rights to open-access resources, renewable versus nonrenewable energy use, and sustainable development. *Prq:* MTHSC 102; C R D 357 or ECON 314.

AP EC 658 Economics of Risk Management 3(3,0) Focuses on cost-benefit analysis of risks, incorporation of economic considerations into risk assessments, and microeconomic analysis of activities, insurance, and policies that reduce, mitigate, or increase these risks. Possible topics include climate change, wildland fire, erosion, pests and invasive species, pestilence, food contamination, and hurricanes. *Prq:* MTHSC 102 and C R D 357 or ECON 314.

- AP EC 660 Agricultural Finance 3(3,0)** Study of the principles and techniques of financing in the agricultural sector. Topics include the capital situation in agriculture, concepts of farm financial management, use of credit, capital markets, lending agencies, and estate planning. Offered spring semester only. *Preq:* ACCT 201, AP EC 202.
- AP EC 675 Economics of Wildlife Management and Policy 3(3,0)** Integrated approach to the study of the economics of wildlife. Topics include determination of market and nonmarket value, single and multiple species management, enterprise cost and returns, marketing wildlife, leasing methods, complementarity and competitiveness with agricultural and forestry enterprises, and timber and crop damage cost estimates and control. *Preq:* AP EC 202, ECON 200, FOR 304, W F B 306, or consent of instructor.
- AP EC (ECON) 800 History of Economic Thought 3(3,0)** See ECON 800.
- AP EC (ECON) 801 Microeconomic Theory 3(3,0)** See ECON 801.
- AP EC (ECON) 802 Advanced Economic Concepts and Applications 3(3,0)** See ECON 802.
- AP EC (ECON) 804 Applied Mathematical Economics 3(3,0)** Discusses mathematical tools needed in economic analysis; matrix algebra, differentiation, unconstrained and constrained optimization, integration and linear programming.
- AP EC (ECON) 806 Econometrics I 3(3,0)** Application of econometric techniques and stochastic models to economic problems. Considers distribution theory, simple and multiple regression modeling, hypothesis testing, and other issues in regression analysis.
- AP EC (ECON) 808 Econometrics III 3(3,0)** See ECON 808.
- AP EC (ECON) 809 Advanced Natural Resource Economics 3(3,0)** Applications of economic theory to problems of natural resource management, epistemological considerations, rent theory, public and private investment criteria, benefit-cost analysis, and general equilibrium management models. Offered spring semester only. *Preq:* ECON (AP EC) 801 or consent of instructor.
- AP EC (ECON) 810 Natural Resources Management and Policy 3(3,0)** Economic, institutional, and legal aspects of control and management of natural resources; concepts of economic science applied to public policy questions related to land and water resources. Specialized background in economics is not necessary. Offered fall semester only. *Preq:* Consent of instructor.
- AP EC (ECON) 811 Economics of Environmental Quality 3(3,0)** See ECON 811.
- AP EC 813 Water Resource Economics 3(3,0)** Discusses benefit-cost analysis of public water development programs, economic analysis of selected water allocation issues, groundwater management, pollution abatement, efficient pricing and valuation, multiple use management, reservoir management, wetland protection, minimum stream flows for endangered species, and environmental and developmental tradeoffs. *Preq:* AP EC (ECON) 822 and ECON 823, or consent of instructor.
- AP EC (ECON) 816 Labor Economics 3(3,0)** See ECON 816.
- AP EC (ECON) 817 Advanced Production Economics 3(3,0)** Discusses production economics theory in a quantitative framework; technical and economic factor-product, factor-factor, and product-product relationships in single- and multi-product firms under conditions of perfect and imperfect competition in both factor and product markets. Offered spring semester only. *Preq:* AP EC (ECON) 804 or consent of instructor.
- AP EC 819 Futures and Options Markets 3(3,0)** Introduction to the economic theory and operation of futures and options markets in the United States. Includes determination of prices and price differences, speculation, and the use of these markets for forward pricing and price risk management. *Preq:* Consent of instructor.
- AP EC (ECON) 820 Public Finance 3(3,0)** See ECON 820.
- AP EC (ECON) 822 Contemporary Public Policy 3(3,0)** Covers contemporary public policy, including price and resource policy, affecting rural areas. Discusses public participation, or the lack thereof, related to programs designed to implement public policy. Offered spring semester only.
- AP EC (ECON) 824 Organization of Industry 3(3,0)** See ECON 824.
- AP EC (ECON) 826 Economic Theory of Government Regulation 3(3,0)** See ECON 826.
- AP EC (ECON) 827 Economics of Property Rights 3(3,0)** See ECON 827.
- AP EC (ECON) 828 Market Structure in Agricultural Industries 3(3,0)** Market structure and other approaches related to agricultural marketing. Individual assignments in the student's field of interest are required. *Preq:* Consent of instructor.
- AP EC (ECON) 831 Economic Development 3(3,0)** See ECON 831.
- AP EC (ECON) 832 Community and Regional Economics 3(3,0)** Covers economic theory and research methods needed to understand happenings in the regional and community economy and how local and non-local decisions influence local economic change. Offered fall semester only. *Preq:* C R D (AP EC) 612 or consent of instructor.
- AP EC (ECON) 840 International Trade Theory 3(3,0)** See ECON 840.
- AP EC (ECON) 841 International Finance 3(3,0)** See ECON 841.
- AP EC (ECON) 855 Financial Economics 3(3,0)** See ECON 855.
- AP EC 881 Internship in Community and Resource Development 1-6** Supervised employment in an agency dealing with socioeconomic aspects, community development, and/or natural resource management. Monthly reports covering the student's experience are required. *Preq:* 18 semester hours of graduate credit.
- AP EC 891 Master's Thesis Research 1-12**
- AP EC (ECON) 899 Selected Topics 1-3(1-3,0)** Selected topics under the guidance of a professor. May be repeated for a maximum of six credits.
- AP EC (ECON) 901 Price Theory 3(3,0)** See ECON 901.
- AP EC 903 General Equilibrium and Welfare Theory 3(3,0)** Second in a two-course sequence in advanced price theory covering the capital theory and the determination of the rate of interest. Offered spring only. *Preq:* ECON (AP EC) 901.
- AP EC (ECON) 906 Seminar in Area Economic Development 3(3,0)** Consideration of recent research developments in economic development. Includes a review of research publications, journal articles, and other literature. Objectives, analytical techniques, and procedures are used in area or regional development efforts. Offered spring semester only. *Preq:* AP EC (ECON) 806.
- AP EC (ECON) 917 Advanced Seminar in Labor Economics 3(3,0)** See ECON 917.
- AP EC (ECON) 950 Monetary Economics 3(3,0)** See ECON 950.
- AP EC (ECON) 991 Doctoral Dissertation Research 1-12**

ARCHITECTURE

- ARCH 605 American Architectural Styles 1650-1950 3(3,0)** Survey of American architectural styles and the architects responsible for them, from the Colonial period to our recent past. Emphasis is on identifying architectural elements that serve as clues in determining a building's architectural style.
- ARCH 612 Architectural History Research 3(3,0)** Directed investigations related to the art and architectural history of Europe. May be repeated for a maximum of six credits. *Preq:* Junior standing or consent of instructor.
- ARCH 614 Design Seminar 3(3,0)** Exploration of topical issues in architecture, art, construction, and planning. May be repeated for a maximum of six credits. *Preq:* Junior standing or consent of instructor.
- ARCH 616 Field Studies in Architecture and Related Arts 3(0,9)** Documentation and analysis of architectural structures observed during European travels in graphic and written form. May be repeated for a maximum of six credits. *Preq:* Junior standing or consent of instructor.
- ARCH 624 Product Design 3(0,9)** Furniture and product system design with emphasis on ergonomics and the relationship of form and materials. *Preq:* Senior standing and consent of instructor.
- ARCH 625 Energy in Architecture 3(3,0)** Climate design methodology and its influence on building energy patterns and architectural form. *Preq:* Senior standing and consent of instructor.
- ARCH 626 Architectural Color Graphics 3(3,0)** Architectural color graphics by computer. Theories of color classification and interaction; application of color theories to art and architecture. *Preq:* Consent of instructor.
- ARCH 627 Advanced Color Graphics 3(3,0)** Theories of color classification and interaction; three-dimensional color modeling by computer; advanced application of color theories to art and architecture. *Preq:* ARCH 426 or consent of instructor.

- ARCH 628 Computer-Aided Design 3(2,3)** Introduction to the concepts, skills, and applications of computer-aided design as they relate to the practice of architecture. *Preq:* Senior standing or consent of instructor.
- ARCH 629 Architectural Graphics 3(3,0)** Provides students with an understanding of concepts, skills, techniques, and strategies of visual presentation/graphics as they relate to the design professions—architects/landscape architects. *Preq:* Graduate standing or consent of instructor.
- ARCH 630 Theories and Philosophies of Technology and Architecture 3(3,0)** Theoretical and practical examination of technology and architecture from pre-modern and modern viewpoints to study its nonneutral role in shaping and reflecting knowledge, beliefs, and actions within a cultural context.
- ARCH 631 Virtual Reality in Architecture 3(3,0)** Introduction and exploration of the theories and concepts of virtual reality and their use in modeling three-dimensional spaces; computer modeling, lighting and texture mapping. Projects focus on the creation and presentation of a virtual environment. *Preq:* Junior standing or consent of instructor.
- ARCH 640 New York Field Study 3(3,0)** Study of architecture, art, planning, and urban design of New York. Two weeks' residence are required with scheduled field trips to relevant sites in all five boroughs, with counseling to determine research interests. Guidance is provided to resources in the city. A final report is required. Offered Maymester only.
- ARCH 685 History and Theory of Architecture + Health 3(3,0)** Introduces relationships between health and architectural settings for health. Examines connections between cultural context, medical thought, health-care delivery, and health facility design within different time periods. Introduces contemporary theories on the relationships between human beings, their health and well-being, and the design of the physical environment. *Preq:* Consent of instructor.
- ARCH 688 Architectural Programming and Pre-design 3(3,0)** Introduces the theory, mechanics, and practice of architectural programming and post-occupancy evaluation. Presents programming as a means to create architectural settings sensitive to the needs of their inhabitants. Emphasizes collaborative methodologies that involve identifying relevant goals, facts, issues, needs, and concepts. Students develop an architectural program. *Preq:* Consent of instructor.
- ARCH 699 Selected Topics in Architecture 1-3(1-3,0)** Study of selected topics in architecture. May be repeated for a maximum of nine credits, but only if different topics are covered. *Preq:* Junior standing or consent of instructor.
- ARCH 801 Architecture Seminar 3(3,0)** Contemporary issues in the architectural profession.
- ARCH 803 Theories of Architecture 3(3,0)** Evolution of architectural theories from Vitruvius to the present. Emphasis is on the writings of leading architects and theorists and the impact of these theories on architectural solutions.
- ARCH 804 Seminar in Modern Masters 3(3,0)** In-depth examination of one or more related groups of architects from the 20th century (Kahn, Scarpa, Barrigan, Wright, Corbusier, etc.). Content varies from semester to semester.
- ARCH 810 Visualization and Representation I 3(3,0)** Develops students' capacity for graphic representation of architectural form and space. Intended as a corollary to ARCH 840; provides the tools necessary to analyze and translate concepts into two-dimensional constructions through the utilization of manual and digital drawing techniques. *Coreq:* ARCH 840.
- ARCH 811 Visualization and Representation II 3(3,0)** Develops and improves student's capacity for the digital and graphic representation of three-dimensional architectural form and space. Introduces and explores the latest technologies—from advanced digital modeling tools to equipment for computer-controlled fabrication. *Preq:* ARCH 810 or equivalent or consent of instructor.
- ARCH 819 Selected Topics in Visualization and Representation 1-5(1-5,0)** Critical consideration of a special topic in architectural visualization and representation from which students construct their own informed and reasoned ideas about what this topic means for their own developing architectural practices. May be repeated for a maximum of six credits. *Preq:* ARCH 810 or equivalent or consent of instructor.
- ARCH 820 Building Design and Construction Principles 3(3,0)** Essential principles for quality design and construction. Emphasis is on design, programming, and sustainability issues for different project types. Nature and characteristics of construction materials, equipment, and systems used in modern buildings are presented as well as how they affect function and feasibility. *Preq:* Consent of instructor.
- ARCH 821 Research Methods 3(3,0)** Covers foundations and procedures of architectural research. Explores alternate research methodologies and their philosophical and epistemological limits.
- ARCH 840 Design Studio 6(0,12)** Studio for students entering the Master of Architecture program with undergraduate degrees in subjects other than Architecture or Environmental Design. Considers aspects of visualization and representation of architecture, the history and theory of architecture, architectural technology, and strategies of design. *Coreq:* ARCH 810.
- ARCH 841 Architecture Studio I 6(0,12)** Studio course focused on increasingly complex works of architecture at various scales for different physical site conditions. *Preq:* ARCH 810 or equivalent.
- ARCH 842 Architecture Studio II 6(0,12)** Studio course focused on architectural materials and assembly. Course is comprised of architectural design explorations of increasing complexity. Students develop a detailed sectional model of their design proposal. *Preq:* ARCH 841.
- ARCH 850 Architecture Studio 6(0,18)** Architectural design studies in the context of the Genoa urban setting. May substitute for ARCH 853 or 854 and for ARCH 857 with consent of advisor.
- ARCH 851 Studio Clemson 6(0,12)** Addresses architectural problems with varied scales, programs, and locations. Emphasizes the relationship between architecture and context. Projects involve collaboration in the studio and with other disciplines to result in architectural solutions for the built environment. Design problems vary according to current issues. May be repeated for a maximum of 12 credits. *Preq:* ARCH 842 or consent of program coordinator.
- ARCH 852 Studio Charleston 6(0,12)** Addresses architectural problems with varied scales and programs in Charleston, SC. Emphasizes the relationship between architecture and context. Projects involve collaboration in the studio and with other disciplines to result in architectural solutions for the built environment. Design problems vary according to current issues in the city of Charleston. May be repeated for a maximum of 12 credits. *Preq:* ARCH 842 or consent of program coordinator.
- ARCH 855 Studio South 6(0,12)** Addresses architectural problems with varied scales and programs in the context of the South. Emphasizes the relationship between architecture, community, and context. Projects involve collaboration with other disciplines in the studio to result in architectural solutions for the built environment. Design problems vary according to current issues in the South. May be repeated for a maximum of 12 credits. *Preq:* ARCH 842 or consent of program coordinator.
- ARCH 857 Architecture Studio 6(0,18)** Architectural design studies dealing with comprehensive problem-solving situations. *Preq:* ARCH 854.
- ARCH 858 Thesis Research 3(0,9)** Architectural pre-design inventory and analysis for the thesis project. *Preq:* ARCH 854.
- ARCH 859 Thesis Manuscript 1-3(0,3-9)** Architectural pre-design synthesis of research for the thesis project. *Preq:* ARCH 858.
- ARCH 861 History and Theory of Modern Architecture 3(3,0)** Overview of architectural concepts drawn from Modernity and current in contemporary architectural discourse. Students critically consider what these concepts mean for their own developing architectural practices. *Preq:* A A H 102 or equivalent.
- ARCH 862 History and Theory of Contemporary Architecture 3(3,0)** View of how art, philosophy, and technology have influenced recent architectural production and thought. Students critically consider these relations towards constructing their own informed ideas about how influences from outside the discipline of architecture might inform their own developing architectural practices. *Preq:* A A H 102 or equivalent.
- ARCH 863 History and Theory of Landscape and Urbanism 3(3,0)** Cultivates different ways of seeing, representing, and understanding the landscape and the city. Both landscape and city are viewed as dynamic, living systems evolving from Roman, Medieval, Baroque, Industrial, Idealized, and non-Western roots and shaped by political, economic, social, cultural, and physical intentions and incidents. *Preq:* A A H 102 or equivalent.

- ARCH 869 Selected Topics in History, Theory, and Criticism 1-5(1-5,0)** Critical consideration of special topics in architectural history, theory, and criticism from which students construct their own informed and reasoned ideas about what the topic means for their own developing architectural practices. May be repeated for a maximum of six credits. *Preq:* A A H 102 or equivalent.
- ARCH 870 Structures I 3(3,0)** Forces and their applications to statically determinant structural components and systems such as shear, moment, and other stress strain patterns are explored in multiple structural materials. *Preq:* PHYS 208/210 or equivalent.
- ARCH 871 Structures II 3(3,0)** Addresses advanced topics in structures, exterior envelopes, and contemporary production technologies. Continues the exploration of structural elements and systems, expanding to include more complex determinant, indeterminate, long-span, and high-rise systems. *Preq:* ARCH 870.
- ARCH 872 Productions and Assemblies 3(3,2)** Overview of traditional and contemporary materials and methods of construction. Combines lectures with hands-on lab experience to examine traditional and contemporary modes of construction, their selection, impact, and reuse.
- ARCH 873 Environmental Systems 3(3,2)** Examines in detail the relationship between human comfort and the design of building envelopes and environmental systems. Covers the evolution of contemporary environmental systems and their appropriate application and integration with other design issues.
- ARCH 874 Building Processes: Technical Resolution 3(1,3)** Develops the designer's ability to assess, select, and conceptually integrate structural systems, building envelope systems, environmental systems, life-safety systems, and building service systems in a sustainable building design.
- ARCH 875 Construction and Building Systems 3(3,0)** Sets a standard level of building technology preparation for entering graduate Architecture students who have an undergraduate architectural degree that included courses in architectural technology. Main focus is on analyzing how construction and building systems contribute to architectural design.
- ARCH 878 Lighting for Architecture 3(3,0)** Studies interrelationships among the fields that constitute lighting and impact on building form, materials and spatial use. Also considers contributions of daylight and electric light to human response and performance. *Preq:* Consent of instructor.
- ARCH 879 Selected Topics in Architectural Technology 1-5(1-5,0)** Critical consideration of special topics in architectural technology from which students construct their own informed and reasoned ideas about what the topic means for their own developing architectural practices. May be repeated for a maximum of six credits.
- ARCH 881 Professional Practice Survey 3(3,0)** Provides an understanding of the basic principles and legal aspects of architectural practice organization: financial management; risk mitigation and arbitration; business planning; time, project, and personnel management; client, owner, and user needs; selecting consultants; project delivery methods; internship, licensure, and registration; professional leadership; ethical standards; and expanding practice settings.
- ARCH 882 Building Economics, Costs, and Legal Issues 3(3,0)** Explores economic factors determining materials, building components, and methods of construction. Legal aspects of design are discussed in the context of building cost. *Preq:* ARCH 881 or consent of instructor.
- ARCH 886 Health Facilities Planning and Design 3(3,0)** Current planning and design considerations for healthcare facilities. Conducted as a series of professional seminars examining overall infrastructural planning and design considerations and detailed considerations for specific areas in hospitals. Topics are covered by Architecture + Health faculty and nationally recognized practitioners. *Coreq:* ARCH 897.
- ARCH 890 Directed Studies 1-5(1-5,0)** Special topics in architecture undertaken on an individual basis with faculty guidance. *Preq:* Consent of advisor.
- ARCH 891 Thesis Project 3-9(0,9-27)** Complex architectural project emphasizing design exploration and independent work. To be taken Pass/Fail only. *Preq:* ARCH 857, 858.
- ARCH 892 Comprehensive Studio 6(0,18)** Architectural design studies addressing comprehensive building projects. Topics include site design, programming, building systems design, and materials selection. Final product is a complete building design with detailed drawings and models. *Preq:* ARCH 857.
- ARCH 893 Synthesis Studio 6(0,12)** Studio themes and programs, defined by individual critics, carry an educational objective and present an opportunity for the critic to develop with his/her students a specific area of work or research. Culminates in a comprehensive proposal. *Preq:* Second-year studio.
- ARCH 894 Research Studio 6(0,12)** Themes and programs, defined by individual critics, carry an educational objective and present an opportunity for the critic to develop with his/her students a specific area of work or research. *Preq:* ARCH 893.
- ARCH 895 Architecture + Health Studio: Selected Projects 3-6(0,6-12)** Studio for students in Architecture + Health Concentration offering selected projects engaging a variety of health-related topics from health community design, sustainable/green architecture, long-term care, and community health-care projects associated with health and wellbeing. Projects executed are similar to professional practice, combining teamwork with individual design alternatives. May be repeated for a maximum of 12 credits. *Preq:* Consent of instructor.
- ARCH 896 Architecture + Health Studio: Tectonic Projects 6(0,12)** Studio for students in Architecture + Health Concentration focused on the design and technical development of small-scale healthcare projects and spaces. Projects are often conducted by interdisciplinary teams as design-build projects where full-scale mock ups are conceived and constructed for evaluation and research. May be repeated for a maximum of 12 credits. *Preq:* Consent of instructor.
- ARCH 897 Architecture + Health Studio: Hospital and Urban Design 3-6(0,6-12)** Studio course for students in Architecture + Health Concentration, focused on the master planning and conceptual design of an academic medical center or hospital within an urban context. The master planning and design problem is preceded by a comparative analysis of both urban structures and hospital structures. May be repeated for a maximum of 12 credits. *Coreq:* ARCH 886.

ART

- ART 605 Advanced Drawing 3(0,6)** Advanced-level studies of drawing which explore the synthesis of refined drawing skills and philosophies of art. Student's understanding of drawing as a form of art is developed through studio practice augmented by critiques, demonstrations, lectures, field trips, and independent research. *Preq:* ART 305 or consent of instructor.
- ART 607 Advanced Painting 3(0,6)** Advanced studio course in painting. Study of contemporary painters and directions is included. Students select painting media and are expected to develop a strong direction based on prior painting experience. *Preq:* ART 307 or consent of instructor.
- ART 609 Advanced Sculpture 3(0,6)** Intensive independent studio concentration to further develop personal direction and content. Emphasis is on continued investigation of sculptural context, materials and processes, and relative historical research. *Preq:* ART 309 or consent of instructor.
- ART 611 Advanced Printmaking 3(0,6)** Culmination of process, techniques, and individual development. Students are expected to have mastered process and technique for the benefit of the image produced. Creativity and self-expression are highly emphasized as students select a process for concentrated study. *Preq:* ART 311 or consent of instructor.
- ART 613 Advanced Photography 3(0,6)** Continuation of ART 313. Advanced problems in photography. *Preq:* ART 313 or consent of instructor.
- ART 617 Advanced Ceramic Arts 3(0,6)** Students are directed toward further development of ideas and skills. Glaze calculation and firing processes are incorporated to allow for a dynamic integration of form and ideas. *Preq:* ART 317 or consent of instructor.
- ART 620 Selected Topics in Art 1-3(0,6-9)** Intense course in studio art. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Senior standing or consent of instructor.

ART 690 Directed Studies 1-5(0,2-10) Study of areas in the visual arts not included in other courses or additional advanced work. Must be arranged with a specific instructor prior to registration. May be repeated for a maximum of 18 credits. *Preq:* Consent of instructor.

ART 803 Fundamentals of Visual Art 3(0,6) Intensive introduction of visual art and design fundamentals. Includes two- and three-dimensional studio work with emphasis on time-based media and design.

ART 805 Visual Arts Seminar on Theories and Practice I 3(3,0) Issues related to the practice of the artist, emphasizing theories and criticism of contemporary art.

ART 806 Visual Arts Seminar on Theories and Practice II 3(3,0) Continuation of ART 805.

ART 813 Photo-Based Imaging Theories and Techniques 3(0,6) Offers in-depth examination of photographic imaging processes for artistic expression, utilizing both traditional and digital tools and concepts. *Preq:* Master of Fine Arts student or consent of instructor.

ART 821 Visual Arts Seminar on Art and Technology 3(3,0) Explores the relationship between art and technology in the age of electronic media. *Preq:* Consent of instructor.

ART 840 Visual Arts Studio 3-6(0,9-18) Studio work in visual arts with adjunct lectures and gallery tours. May be substituted for ART 800-level visual arts studio.

ART 850 Visual Arts Studio 3(0,9) Concentrated and advanced work in ceramics, drawing, painting, printmaking, sculpture, photography, graphic design, or multimedia. *Preq:* Consent of department chair or instructor.

ART 851 Visual Arts Studio 3-6 Continuation of ART 850. May be repeated for maximum of six credits. *Preq:* Consent of department chair or instructor.

ART (CP SC) 860 Studio Computer Research 3-15(0,6-30) Application of computer technology for the production of art. Computer research facilitates the creative approach to self-expression. Internships at animation production houses may be used for credit in this course. May be repeated for a maximum of 27 credits. *Preq:* Consent of instructor.

ART 870 Visual Arts Studio 6(0,16) Advanced theory; directed research in art criticism; applied work in ceramic arts, drawing, painting, sculpture, photography, graphic design, or multimedia. *Preq:* Consent of department chair or instructor.

ART 871 Visual Arts Studio 3-6(0,8-16) Continuation of ART 870. May be repeated for maximum of six credits. *Preq:* Consent of department chair or instructor.

ART 880 Visual Arts Studio 3-15(0,6-30) Continuation of ART 871. May be repeated for maximum of 15 credits. *Preq:* Consent of department chair or instructor.

ART 891 Master's Thesis Research 3-15(0,6-30) May be repeated for maximum of 15 credits. *Preq:* Consent of department chair or instructor.

ART AND ARCHITECTURAL HISTORY

A A H 611 Directed Research in Art History I 3(3,0) Comprehensive studies and research of special topics not covered in other courses. Emphasis is on field studies, research activities, and current developments in art history.

A A H 612 Directed Research in Art History II 3(3,0) Continuation of A A H 611.

A A H 623 Studies in the Art and Architecture of the Renaissance I 3(3,0) Consideration of the visual arts and architectural monuments of the Renaissance (Western Europe from the 15th-18th centuries), with a study in depth of selected examples from the period. *Preq:* A A H 204 or 206 or consent of instructor.

A A H 624 Studies in the Art and Architecture of the Renaissance II 3(3,0) Consideration of the visual arts and architectural monuments of the Renaissance (Western Europe from the 15th-18th centuries), with a study in depth of selected examples from the period. *Preq:* A A H 423.

A A H 630 Twentieth Century Art I 3(3,0) Acquaints students with the major artists' monuments and issues of the Modern period in art. Through lecture/discussions and the reading of primary sources, course places the major modern movements in the context of the period (1860s-1945). *Preq:* Consent of instructor.

A A H 632 Twentieth Century Art II 3(3,0) Overview of trends in art and architecture since World War II. Specific artists, artworks, and movements are presented in a socio/historic context with specific emphasis on the transition from a late-modernist to a post-modern perspective. *Preq:* Consent of instructor.

A A H (PHIL) 633 Issues in Contemporary Art and Philosophy 3(3,0) See PHIL 633.

A A H 815 Art and Architectural History Seminar I 3(3,0) Particular aspect of period of art/architectural history. *Preq:* Consent of instructor.

A A H 816 Art and Architectural History Seminar II 3(3,0) Continuation of A A H 815.

A A H (COMM, ENGL) 840 Selected Topics 3(3,0) See ENGL 840.

ASTRONOMY

ASTR 802 Stellar Structure and Evolution 3(3,0) Physical principles governing the structure, power, luminosity, and evolution of stars; equation of state, equations for pressure and thermal balance, heat transport, thermonuclear power, and numerical techniques of structure calculation. *Preq:* PHYS 455 or equivalent or consent of instructor.

ASTR 803 Galactic Structure 3(3,0) Kinematics, dynamics, and content of the Milky Way galaxy; galactic rotation, galactic distance scale, stellar populations, spiral structure, the galactic center, and the evolution of the Milky Way and other galaxies. *Preq:* Consent of instructor.

ASTR 875 Selected Topics 1-3(1-3,0) Study of one or more advanced topics in contemporary astrophysics. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.

ATHLETIC LEADERSHIP

A L 653 Athletic Injuries: Prevention, Assessment and Rehabilitation 3(3,0) Gives students an understanding of prevention, treatment, and rehabilitation procedures of injured athletes. *Preq:* A L 349.

AUTOMOTIVE ENGINEERING

AU E 805 Ground Vehicle Aerodynamics 3(3,0) Basic and applied aspects of aerodynamics relevant for internal and external design for performance, including drag, handling, noise, and ventilation. Wind tunnel and track testing methods and computational modeling approaches are utilized.

AU E 816 Engine Combustion and Emissions 3(2,3) Spark and compression ignition engines are investigated in terms of design, performance, and emissions. Includes exergy models. Integrates theory of fuel air cycles with laboratory breakdown and dynamometer testing to correlate prevalent mathematic models with test results.

AU E 817 Alternative Energy Sources 3(3,0) Demand for petroleum alternative propulsion sources has focused attention on hybrid vehicles with fuel cells, electric motors, and battery packs and internal combustion engines burning hydrogen and reformulated fuels. Comparison of performance, emissions, fuel efficiency, operational requirements, and vehicle configurations is studied.

AU E 825 Automotive Sensors and Actuators 3(3,0) Study of automotive sensor and actuator requirements, design, and selections as well as future needs. Sensor and actuator networks, noise and interference issues, wired and wireless systems are examined as well as integrated smart sensors and actuators with applications to traditional and intelligent vehicle systems.

AU E 826 On-Board Vehicle Diagnostics and Reliability 3(3,0) Discussion of legislated state, federal, and international requirements. On-board automotive sensors to monitor vehicle operation and typical diagnostic algorithms are studied. Includes analytical methods for designing fault-tolerant systems and assessing vehicle reliability including safety-critical systems and "limp-home" modes, as well as use of hand-held scanners and specialized diagnostic equipment to classify faults.

AU E 827 Automotive Control Systems Design 3(3,0) Investigation into derivation of models and design of control strategies for powertrain and chassis control modules and integration into automotive platforms. Also presents software design, sensor selection, system architecture, diagnostics, and reliability issues. Application is made to engine management, transmission and chassis systems with a consideration of vehicle performance, safety, and information provision. *Preq:* M E 416 or equivalent.

- AU E 828 Fundamentals of Vehicle Drivelines and Powertrain Integration 3(3,0)** Study of vehicle powertrain arrangement, manual and automatic transmissions, automotive axles, four-wheel and two-wheel drives, and design and manufacturing of gearing systems. Other topics, such as powertrain control to address dynamics in shifting, engine balancing, and fuel economy, are addressed. Modeling and computer simulation are used extensively to analyze dynamic performance of various transmissions. *Preq:* M E 405, 416, or consent of instructor.
- AU E 829 Tire Behavior and Its Influence on Vehicle Performance 3(3,0)** In-depth analysis of the tire and its influence on vehicle performance including design, construction, structural response, rolling resistance, force and moment generation, and behavior under dry/wet conditions. Tire models, their limitations and governing equations, tire characteristics on vehicle handling and safety, and advanced control concepts in vehicle stability/braking are investigated. *Preq:* M E 453 or equivalent.
- AU E 847 Vehicle Suspension Systems Design and Analysis 3(3,0)** Study of concepts, theory, design, and application of automotive suspension systems. Discusses suspension structure, configuration, geometry, kinematics, motion, static and dynamic load conditions as well as active, semi-active, and passive systems. Suspension design factors and their effects are presented. Computer-aided engineering tools and other analytical techniques are demonstrated. *Preq:* M E 453 or equivalent.
- AU E 848 Vehicle Braking Systems 3(3,0)** Study of vehicle braking performance; development of system specifications; regulatory, customer, and manufacturing requirements; brake balance and effects on stability and stopping distance; ABS systems; and computer simulation for system performance. *Preq:* M E 453 or equivalent.
- AU E 849 Automotive Chassis Design 3(3,0)** Integrative systems approach to the design and manufacture of automotive chassis and body components. Considers influence of design and manufacture on overall structural performance of the automobile, ride comfort, safety, durability, weight, and cost. *Preq:* AU E 855 or equivalent, AU E 881.
- AU E 850 Automotive Stability and Safety Systems 3(3,0)** Discussion of passive/active systems and design philosophies. Investigates stability issues associated with vehicle performance and use of sensors and control system strategies for stability enhancement. Implementation and application to intelligent cruise control, lane departure warning systems, ABS, traction control, active steering systems, and vehicle dynamic control systems are also discussed. *Preq:* M E 453 or equivalent.
- AU E 853 Crash Analysis Methods and Crashworthiness 3(3,0)** Consideration of crash legislation and testing; design constraints for crash; computational methods to analyze the mechanical response of automotive structure, systems, and components to dynamic impact loading such as in crash situations; crush characteristics, structural collapse, and their influence on safety; large-scale finite element analysis for large-scale deformation. *Preq:* AU E 852, 855, or consent of instructor.
- AU E 855 Structural/Thermal Analysis Methods for Automotive Structure, Systems, and Components 3(3,0)** Methods to analyze the response of automotive structure, systems, and components to static, dynamic, and thermal loading. Includes coverage of critical loading conditions and system response objectives. Analysis methods focus on finite element approaches supplemented by simple computational methods when appropriate.
- AU E 866 Advanced Materials for Automotive Applications 3(3,0)** In-depth study of the broad range of engineering materials used in the construction of motor vehicles. Considers interrelations between materials microstructure, components manufacturing process, and components service behavior. *Preq:* Consent of instructor.
- AU E 867 Vehicle Manufacturing Processes I 3(3,0)** In-depth analysis of main component and subsystem prototyping, fabrication assembly, and integration processes used during production of automotive vehicles. Also discusses design for manufacturing, computer-aided manufacturing, and rapid tooling technologies. *Preq:* Consent of instructor.
- AU E 868 Vehicle Manufacturing Processes II 3(3,0)** Continuation of AU E 867 with more emphasis placed on opportunities and challenges presented by automotive manufacturing in a global environment, integrated processes and product development, and flexible and agile manufacturing. *Preq:* AU E 867.
- AU E 875 Vehicle Development and Realization 3(3,0)** In-depth analysis of component and subsystems design, representation, data management, and analysis for vehicles. Voice of the customer, customer-driven design, product design specifications, life cycle product management, CAD/CAE representations, domestic and international standards, prototyping, design review, and supplier relationships are considered using case studies.
- AU E 876 Mass Customization Design for Vehicles 3(3,0)** Consideration of concepts of platforms and product families, identification of common functionalities, and the translation of functions into forms taking commonality into consideration. Also investigates designing product families and their role in vehicle design, the tie between market needs and appropriate manufacturing paradigm, and specific applications to vehicle systems designs: chassis, wiring harnesses, engines.
- AU E 877 Light-Weight Vehicle Systems Design 3(3,0)** Methodological approaches to weight trade-off during design of vehicle systems, accounting for other functions, cost, safety, materials characteristics, and manufacturing constraints. Includes topology optimization, multimaterial approaches, and identification of the function optimal materials and material combinations using multi-objective formulations.
- AU E 880 Vehicle Design/Manufacture Project Management 3(3,0)** Development of management, leadership, sociocultural, and technical skills training for the successful management of an automotive development or research team. Includes problem identification, team dynamics, decision making, ethics, strategy setting, project planning, scope management and implementation, target costing, marketing, design methods, and design for X-concepts.
- AU E 881 Automotive Systems: An Integrated Overview 3(3,0)** Promotes understanding of the vehicle as a complex system and interactions of its subsystems in terms of performance. Topics include propulsion systems, suspensions and steering systems, tire-road interface, structural behavior and crashworthiness, materials and manufacturing, driver/occupants-vehicle interactions, and onboard electronics. Modeling and simulation are used.
- AU E 882 Systems Integration Concepts and Methods 3(3,0)** Study of methods and tools to handle functional, geometric, production, and IT integration. Includes instruction in managing performance trade-offs from the combination of systems designed for individual functions. Topics also include optimization methods, complexity, validation, signal, and IT design and testing methods, robustness, architecture, and quality.
- AU E 883 Applied Systems Integration 3(2,3)** Application of integration methods to practical and complex vehicle design and manufacturing systems. Includes prototyping, measurements, tolerancing, and validation, as well as diagnosis and sensitivities, methods to diagnose sporadic software errors with hardware in the loop, design reviews, FMEA on function signal, geometry, production. Also includes Fault Tree analysis, innovation and change management, risk analysis, and value analysis. *Preq:* M E 882, consent of instructor.
- AU E 884 Styling Design 3(3,0)** Considers fundamentals of styling design for the outer body and the interior cockpit. Utilizes concept sketching, drawing, and prototyping, including virtual and physical, layered, and clay based. Includes 2-D and 3-D representations, brand identifications, textures, materials, lighting, colors, and their use in automotive industrial design.
- AU E 885 Vehicle Layout Engineering and Ergonomic Design 3(2,3)** Study of vehicle layout specifications and considerations related to exterior and interior design. Ergonomics methods and tools as related to occupant accommodation and driver function are presented. Issues of assembly and manufacturing ergonomics are also covered. Case studies are utilized.
- AU E 886 Vehicle Noise, Vibration, and Harshness 3(3,0)** Application of engineering tools and specifications for noise, vibrations, and harshness. Sources, mitigation methods, complexity, and influences on other vehicle functions are considered. Utilizes design, simulation, and validation methods. *Preq:* M E 845 or equivalent.
- AU E 887 Methods for Vehicle Testing 3(2,3)** Investigates test planning for various performance regimes, data acquisition and analysis, uncertainty analysis, sensor selection, noise filtering, data reduction methods, and track testing methods. Project includes actual vehicle tests.
- AU E 890 Automotive Engineering Project 1-3(0,3-9)** Industrial project work culminating in writing engineering reports. Projects cover comprehensive analytical and/or experimental treatment of phenomena of current interest in automotive engineering emphasizing modern technological problems. May be repeated for a maximum of nine credits.

AU E 893 Selected Topics in Automotive Engineering 3(3,0) Advanced concepts in multibody systems dynamics including kinematics and kinetics of multibody systems, various methods for equation formulation and their limitations, numerical solutions methods, and applications to automotive systems and subsystems.

AU E 991 Doctoral Dissertation Research 1-12

BIOCHEMISTRY

BIOCH 606 Physiological Chemistry 3(3,0)

Studies chemical basis of the mammalian physiological processes of muscle contraction, nerve function, respiration, kidney function, and blood homeostasis. Discusses composition of specialized tissue such as muscle, nerve, blood, and bone and regulation of water, electrolytes, and acid-base balance. *Preq:* BIOCH 305 or Organic Chemistry.

BIOCH 623 Principles of Biochemistry 3(3,0)

Study of the chemistry of amino acids, monosaccharides, fatty acids, purines, pyrimidines, and associated compounds leads to an understanding of their properties and the relationship between structure and function that makes them important in biological processes. The use of modern techniques is stressed. *Preq:* CH 224 or equivalent.

BIOCH 631 Physical Approach to Biochemistry 3(3,0)

Study of chemical and physical properties of amino acids, lipids, nucleic acids, sugars, and their biopolymers. Physical and mathematical analyses are correlated with biological structure and function. *Preq:* BIOCH 301 with a C or better or consent of instructor. *Coreq:* Physical Chemistry.

BIOCH 632 Biochemistry of Metabolism 3(3,0)

Study of central pathways of carbohydrate, lipid, and nucleotide metabolism. Bioenergetics, limiting reactions, and the regulation and integration of the metabolic pathways are emphasized. *Preq:* BIOCH 423 or 431 or consent of instructor.

BIOCH 633 General Biochemistry Laboratory I 2(0,4)

Experiments selected to illustrate current methods used in biochemical research. *Coreq:* BIOCH 423 or 431.

BIOCH 634 General Biochemistry Laboratory II 2(0,4)

Continuation of BIOCH 433. *Preq:* Concurrent enrollment in BIOCH 432.

BIOCH 636 Nucleic Acid and Protein Biosynthesis 3(3,0)

Examines how nucleic acids and proteins are synthesized in prokaryotic and eukaryotic cells. Designed for students interested in biochemistry, cell biology, molecular biology, and cell physiology. *Preq:* BIOCH 423, 431 or 432 or consent of instructor.

BIOCH (GEN) 640 Bioinformatics 3(3,0)

See GEN 640.

BIOCH 643 Biochemical Basis of Disease 3(3,0)

Topics in heritable human metabolic disorders including clinical features and newborn screening, genetic testing, the biochemical basis, and treatment. *Preq:* BIOCH 301, GEN 302, or consent of instructor.

BIOCH (GEN) 805 Issues in Research 2(2,0)

Scientific writing, oral presentations, and critical evaluation of them; legal and ethical issues associated with modern biochemical research. Science job hunting, time management, and creativity for professional scientists are treated. *Preq:* Graduate enrollment in Biochemistry and Molecular Biology or consent of instructor.

BIOCH (GEN) 810 Principles of Molecular Biology 3(3,0)

Introduction to the principles and techniques used to analyze prokaryotic and eukaryotic gene and genome structure, regulation of transcription initiation, regulation of protein synthesis and protein function. *Preq:* Enrollment in Genetics or Biochemistry and Molecular Biology or consent of instructor.

BIOCH 814 Advanced Biochemistry 3(3,0)

Contemporary topics of functional and cellular aspects in biochemistry with particular focus on new observations, emerging ideas, and important techniques. *Preq:* Two-semester sequence in biochemistry or consent of instructor.

BIOCH 815 Lipids and Biomembranes 3(3,0)

Discusses isolation, chemical and physical properties, and metabolism of lipids; purification, structure, function, and biosynthesis of biomembranes. *Preq:* BIOCH 632 or consent of instructor.

BIOCH 816 Signal Transduction 3(3,0)

Characteristics and components of signal transduction processes in model species of plants, animals, and microbes. *Preq:* BIOCH (GEN) 810 and GEN (BIOCH) 820, or consent of instructor.

BIOCH 818 Cellular Metabolism 3(3,0)

Evolution, regulation, characterization, and manipulation of metabolic pathways. *Preq:* BIOCH 814 and GEN (BIOCH) 820, or consent of instructor.

BIOCH (GEN) 820 Genomics and Proteomics 3(3,0)

See GEN 820.

BIOCH 821 Proteins 3(3,0)

Isolation, composition, structure, and properties of proteins; methods of isolation, analysis, and characterization; properties of "unusual" protein systems. *Preq:* BIOCH 623 or 631 or consent of instructor.

BIOCH 822 Enzymes 3(3,0)

Kinetics, mechanisms of action, inhibitions, and general properties of enzymes. *Preq:* BIOCH 623 or 631.

BIOCH (GEN) 825 Seminar I 1(1,0)

See GEN 825.

BIOCH 828 Supramolecular Structure 3(3,0)

Cellular structures such as viruses, ribosomes, and various membrane systems, including rafts and some organelles, are described using modern methods of structural characterization. The methods and the theory of the methods are discussed along with the structures and their functions. *Preq:* BIOCH 814 or consent of instructor.

BIOCH 832 Structure and Function of Nucleic Acids 3(3,0)

Physical, chemical, and biochemical properties of nucleotides, oligonucleotides, RNA, and DNA; antisense oligonucleotides and aptmers; unusual structures of RNA and DNA; nucleic acids-protein interactions; nucleic acids-metal interactions; small RNAs and RNA interference; catalytic nucleic acids; nucleic acids repair. *Preq:* BIOCH 814 or GEN 814 or consent of instructor.

BIOCH 841 Biochemical Genetics 3(3,0)

Regulation of replication and transcription. Students present papers from recent literature and write a research proposal. *Preq:* One year of biochemistry or consent of instructor.

BIOCH (GEN) 851 Seminar II 1(1,0)

Investigation of current topics in biochemistry. May be repeated for a maximum of ten credits. To be taken Pass/Fail only.

BIOCH 890 Special Topics in Biochemistry 1-6(1-6,0)

Group discussions of recent developments in biochemical research. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* BIOCH 814 or consent of instructor.

BIOCH 891 Master's Thesis Research 1-12

BIOCH 991 Doctoral Dissertation Research 1-12

BIOENGINEERING

BIO E (C M E) 615 Research Principles and Concepts 1(1,0)

Introduces seniors and graduate students to principles and practices of scientific research. Topics include developing scientific concepts, developing projects, pursuing research, collaborating in multidisciplinary teams, patenting and publishing technical and scientific information, and reviewing professional and ethical standards of performance. To be taken Pass/Fail only.

BIO E 640 Biotechnology for Bioengineers 3(3,0)

Explores the principles necessary to use microorganisms, tissue culture, and enzymes in bioengineering applications, including molecular techniques, fermentation, process scale-up, purification processes, and FDA regulations. Emphasizes production of biopharmaceuticals derived from recombinant systems, including uses in medical systems. *Preq:* BIOCH 305 or consent of instructor.

BIO E 800 Seminar in Bioengineering Research 1(2,0)

Original research in bioengineering; weekly one-hour seminar associated with weekly recitation covering seminar preparation, presentation, professional writing, bioengineering ethics, and related topics. To be taken Pass/Fail only.

BIO E 801 Biomaterials 3(3,0)

Structure and properties of the main classes of materials used in artificial organs and surgical implants; metals, ceramics, polymers, composites, and materials of biological origin; mechanical properties, corrosion, and design. *Preq:* Consent of instructor.

BIO E 802 Compatibility of Biomaterials 3(1,6)

Determining compatibility of biomaterials with the physiological environment; optical microscopy, microradiography, and ultraviolet fluorescence; normal histology of tissues, basic pathological reactions, and tissue reactions to materials.

BIO E 803 Polymeric Biomaterials 3(3,0)

Interplay of physicochemical properties of polymeric materials and the design of biomedical devices and their in vitro and in vivo performance; critical manufacturing aspects of selected augmentation and prosthetic devices for soft and hard tissues; analysis of case studies and reports on recent research findings. *Preq:* Consent of instructor.

BIO E 807 Nanotechnology and Biomaterials 3(3,0) The emerging field of nanotechnology and its relation to solving bioengineering and health-related problems is treated. Also considers the promise of nanotechnology in the creation and utilization of materials and devices at the level of atoms and molecules. New scientific approaches, research tools, clinical tools, and devices are presented.

BIO E 812 Orthopedic Engineering and Pathology 3(3,0) Interdisciplinary study of orthopedic cases (bone growth, bone remodeling, osteoarthritis, implant fixation, and joint replacements); bio-mechanical, biomaterials, and clinical diagnosis of failed implants (total joints, fracture fixation, and spinal instrumentation); basic concepts of orthopedic pathology for engineers. *Preq:* BIO E 801, 802, 820, and 882, or consent of instructor.

BIO E 820 Structural Biomechanics 3(3,0) Mechanical functions of the human body treated as an engineering structure and the devices used to assist and supplement these functions; movement of the musculoskeletal system; locomotion; gait; prehension; lifting; function of artificial limbs; orthopedic prostheses and braces; effect of vibration and impact on the body; mathematical and other models of the body. *Preq:* Consent of instructor.

BIO E 823 Vascular Engineering and Pathology 2(2,0) Medical and bioengineering aspects of artificial vascular and cardiovascular devices; physiology and pathological aspects of patients with need for such devices; diagnostic techniques and surgical management of diseases and pathology; design aspects of current devices and selection; state-of-the-art in experiments and human clinical trials. *Preq:* BIO E 801, 802, and 846, or consent of instructor.

BIO E 824 Cellular and Molecular Analysis in Tissue Engineering 4(3,3) Describes the molecular basis for cell regulation by extracellular stimuli including growth factors, matrix, and force. Also describes theoretical and laboratory instruction in research methods used to analyze cellular signaling and functional response in the design and evaluation of tissue engineering constructs. *Preq:* BIO E 849 or consent of instructor.

BIO E 846 Biomedical Basis for Engineered Replacement 3(3,0) Form and function of human organs, major systems, and examples of engineering repair and replacement methods are presented in light of pathological or traumatic organ malfunction. Core course for all Bioengineering graduate students, taken preferably during their first fall semester.

BIO E 847 Transport Processes in Bioengineering 4(4,0) Cardiovascular systems and regulation; physiology of blood, heart, and organ blood flow; properties of blood as a fluid; fluid flow equations; turbulence; pulse propagation; respiration and control of breathing; gas exchange; heart-lung bypass devices; renal function and control; artificial kidney devices; heat flow and temperature regulation. *Preq:* BIOSC 459.

BIO E 848 Cellular Interactions with Biomaterials 4(2,2) Cell biological concepts and issues relevant to cell-biomaterial interactions; methods for studying cell structure and function including basic cell culture techniques and in vitro biocompatibility analyses; biomaterial physio-chemical properties which influence cellular interactions; interactions between implant materials and host tissues at the cellular and molecular level; overview of tissue engineering.

BIO E 849 Tissue Engineering 3(3,0) Principles and practices of bioartificial organ and tissue development; cellular/material interaction and translation of information from two-dimensional surfaces to three-dimensional scaffolds; selection and processing of biomaterials to form tissue scaffolds; analysis of tissue engineered devices, standards, and regulation. *Preq:* BIO E 801, 846.

BIO E 850 Selected Topics in Biomedical Engineering 1-4(0-4,12-0) Advanced topics in bioengineering intended to develop in-depth areas of particular student interest. Credit may be earned for more than one semester. *Preq:* Consent of instructor.

BIO E 870 Bioinstrumentation 3(2,2) Concepts and techniques of instrumentation in bioengineering emphasizing effects of instrumentation on the biological system under investigation; transducers and couplers; data conversion; conditioning and transmission; experimental problems in acute and chronic procedures with static and dynamic subjects.

BIO E 871 Biomedical Imaging in Biophotonics 3(3,0) Study of biophotonics, an interdisciplinary subject of applying photonics to diagnose and manipulate biological samples from individual cells to the entire human body. Introduces fundamental and frontier topics in the optical imaging aspect of biophotonics for graduate students to gain the ability to solve bioimaging-related biomedical problems. *Preq:* E C E 320, MTHSC 208, PHYS 221 (or their equivalents); or consent of instructor.

BIO E 882 Biomaterials Implantology 4(2,6) All phases of experimental surgery including selection of animal models, preparation of animals for surgery, general and special surgical techniques, and basic and applied instrumentation. *Preq:* BIOSC 459 or equivalent.

BIO E 890 Internship 1-5 Observation and assignment in a medical college, dental college, hospital, veterinary clinic, dental clinic, health service, or industrial department. *Preq:* Consent of department chair.

BIO E 891 Master's Thesis Research 1-12

BIO E 892 Nonthesis Independent Study in Bioengineering 1-6 Independent study in bioengineering for work necessary to complete requirements for the Master of Science degree in Bioengineering, nonthesis option. May be repeated for additional credit. To be taken Pass/Fail only.

BIO E 991 Doctoral Dissertation Research 1-12

BIOLOGICAL SCIENCES

BIOSC (ENT) 600 Insect Morphology 4(3,3)
See ENT 600.

BIOSC 601 Plant Physiology 3(3,0) Relations and processes that pertain to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. *Preq:* BIOL 104/106 or 111 or BIOSC 205 and CH 102. *Coreq:* BIOSC 602.

BIOSC 602 Plant Physiology Laboratory 1(0,3) Laboratory exercises and experiments designed to indicate the relations and processes that pertain to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products and liberation of energy. *Coreq:* BIOSC 601.

BIOSC (GEN) 605 Molecular Genetics of Eukaryotes 3(3,0) See GEN 605.

BIOSC 606 Introductory Plant Taxonomy 3(3,0) Introduction to the basic principles and concepts of plant systematics with emphasis on the plants of South Carolina. *Preq:* BIOL 104/106 or 111 or BIOSC 205. *Coreq:* BIOSC 607.

BIOSC 607 Plant Taxonomy Laboratory 1(0,3) Introduction to the basic techniques of plant taxonomy with laboratory and field emphasis on the flora of South Carolina. *Coreq:* BIOSC 606.

BIOSC 608 Comparative Vertebrate Morphology 3(3,0) Phylogeny and diversity of vertebrates and study of their comparative morphology, leading to an understanding of the relationships and functioning of living organisms. *Preq:* BIOL 104 or 111. *Coreq:* BIOSC 609.

BIOSC 609 Comparative Vertebrate Morphology Laboratory 2(0,5) Comparative anatomy of representative vertebrates; methods used in preparing specimens for study and display. *Coreq:* BIOSC 608.

BIOSC 610 Limnology 3(3,0) Detailed introduction to the physical, chemical, and biological interrelationships that characterize inland water environments. A fundamental approach to the interactions of components of the environment is developed at a theoretical level. *Preq:* Junior standing in a life science or consent of instructor.

BIOSC 611 Limnological Analyses 2(1,2) Examines a broad range of topics covered with both standing and running fresh waters. About one-third of the laboratory exercises address the major physical components of lakes and streams. The remainder provides rationale and methods for quantitative analyses of biota, as well as some integrated analyses of whole ecosystems. *Preq* or *Coreq:* BIOSC 610 or 643.

BIOSC (E N R) 613 Restoration Ecology 3(3,0)
See E N R 613.

BIOSC (AVS, MICRO) 614 Basic Immunology 4(3,3) See MICRO 614.

BIOSC (ENT) 615 Insect Taxonomy 3(1,6)
See ENT 615.

BIOSC (GEN) 616 Recombinant DNA 3(3,0)
See GEN 616.

- BIOSC 617 Marine Biology 3(3,0)** Survey of organisms that live in the sea and their adaptations to the marine environment. Emphasizes characteristics of marine habitats, organisms, and the ecosystems. *Preq:* BIOL 104/106, 111, or consent of instructor.
- BIOSC (GEN, MICRO) 618 Biotechnology I: Nucleic Acids Techniques 4(2,4)** See GEN 618.
- BIOSC 620 Neurobiology 3(3,0)** Broad background in neurobiology. Topics include neuro-anatomical structure-function; conduction in the neuron; neurite growth and development; neuromuscular junction; chemistry, physiology, and pharmacology of specific neurotransmitters and receptors; visual process; axoplasmic transport; hypothalamic-pituitary regulation; theories of behavior; theories of learning and memory. *Preq:* BIOCH 301 or 305 or consent of instructor.
- BIOSC (PL PA) 625 Introductory Mycology 3(3,0)** Introduction to the biology of all the groups of fungi and some related organisms, with considerations of the taxonomy, morphology, development, physiology, and ecology of representative forms. *Preq:* BIOL 104/106 or 111 or BIOSC 205. *Coreq:* BIOSC (PL PA) 626.
- BIOSC (PL PA) 626 Mycology Practicum 2(1,3)** Application of the principles of mycological techniques, including isolation, culture, identification, and microscopic study of fungi. Includes examples from all major groups of fungi. *Coreq:* BIOSC (PL PA) 625.
- BIOSC 632 Animal Histology 3(3,0)** Structural and functional study of the basic tissues of animals and tissue makeup of organs. Emphasis is on light microscopy level with selected tissue studied at the electron microscope level. *Preq:* BIOSC 303 or consent of instructor. *Coreq:* BIOSC 633.
- BIOSC 633 Animal Histology Laboratory 2(1,2)** Microscopic examination of basic animal tissue types and the tissue makeup of organs which comprise systems. *Coreq:* BIOSC 632.
- BIOSC (ENT) 636 Insect Behavior 3(2,3)** See ENT 636.
- BIOSC 640 Developmental Animal Biology 3(3,0)** Events and mechanisms responsible for the development of multicellular animals. Gametogenesis, fertilization, embryonic development, cellular differentiation, morphogenesis, larval forms and metamorphosis, asexual reproduction, regeneration, malignancy, and aging are analyzed in terms of fundamental concepts and control processes. *Preq:* BIOCH 301 or 305 or consent of instructor. *Coreq:* BIOSC 650.
- BIOSC 641 Ecology 3(3,0)** Study of basic ecological principles underlying the relationships between organisms and their biotic and abiotic environments. Includes physiological, population, and community ecology, with applications of each to human ecological concerns. *Preq:* BIOL 104/106, 111, BIOSC 205, or consent of instructor.
- BIOSC 642 Biogeography 3(3,0)** Study of patterns of distribution of plants and animals in space and time. *Preq:* BIOSC 302 or 303 and 304 or 305 or consent of instructor.
- BIOSC 643 Freshwater Ecology 3(3,0)** Study of basic ecological principles and concepts as they apply to freshwater environments: rivers and streams, wetlands, lakes and ponds, and reservoirs. *Preq:* Junior standing in a life science or consent of instructor.
- BIOSC 644 Freshwater Ecology Laboratory 2(1,2)** Laboratory-based course providing a synthesis of major components of freshwater ecosystems. Activities are hypothesis driven and relate to each other to form an overall synthesis of the field. Hands-on experience allows engagement in creative inquiry. *Preq or Coreq:* BIOSC 443 or equivalent of consent of instructor.
- BIOSC 645 Ecology Laboratory 2(1,2)** Modern and classical approaches to the study of ecological problems discussed in BIOSC 441. Students are introduced to field, laboratory, and computer-based analyses of plant and animal populations and communities. *Preq or Coreq:* BIOSC 641.
- BIOSC 646 Plant Ecology 3(3,0)** Ecology of plants in relation to their biotic and abiotic environments. Individual organisms, populations, and communities are considered with an emphasis on seed plants in terrestrial environments. *Preq:* BIOL 104/106, 111, or BIOSC 205, or consent of instructor.
- BIOSC 647 Plant Ecology Laboratory 2(1,2)** Experimental and observational approach to addressing principles discussed in BIOSC 646. Students are introduced to field and laboratory methods involving individual organisms, populations, and communities. *Preq or Coreq:* BIOSC 646 or consent of instructor.
- BIOSC 650 Developmental Biology Laboratory 2(1,2)** Examines a broad range of topics concerned with the development of multicellular animals such as gametogenesis, fertilization, embryonic development, cell differentiation, morphogenesis, larval metamorphosis, and regeneration. Laboratory exercises provide the rationale and methods for the descriptive and experimental analysis of development in representative invertebrates and vertebrates. *Preq or Coreq:* BIOSC 640 or equivalent.
- BIOSC 652 Plant Anatomy and Morphology 3(3,0)** Study of the anatomy, reproduction, and phylogenetic relationships of vascular plants. *Preq:* BIOL 104/106, 111, BIOSC 205, or consent of instructor.
- BIOSC 653 Plant Anatomy and Morphology Laboratory 2(1,2)** Laboratory focusing on the anatomy, reproduction and phylogenetic relationships of vascular plants. *Coreq:* BIOSC 652.
- BIOSC 654 Plant Virology 4(3,3)** Study of plant viruses: their morphology, biochemistry, purification, and transmission; symptoms resulting from virus infection; virus vector relationships. Serological and nucleic acid hybridization procedures. Diagnosis of viral diseases and the identification of causal agents. Replication of plant viruses, the interaction between viral host and plant genome. Control of plant viral diseases. *Preq:* BIOCH 301, MICRO 305, or consent of instructor.
- BIOSC (ENT) 655 Medical and Veterinary Entomology 3(2,3)** See ENT 655.
- BIOSC 656 Medical and Veterinary Parasitology 3(3,0)** Introduction to parasitism in the animal kingdom; emphasizes basic and applied principles related to economically and medically important diseases. Classical and experimental approaches to the study of parasitism are examined in reference to protozoa, helminths, and arthropods. *Preq:* BIOL 104/106 or 111. *Coreq:* BIOSC 657.
- BIOSC 657 Medical and Veterinary Parasitology Laboratory 2(1,2)** Laboratory to reinforce material presented in BIOSC 656. Introduces students to both live and preserved human/animal parasites. Also introduces techniques used in collection, preservation, and examination of animal parasites. *Coreq:* BIOSC 656.
- BIOSC 658 Cell Physiology 3(3,0)** Study of the chemical and physical principles of cell function emphasizing bioenergetics and membrane phenomena. *Preq:* BIOCH 301 or 305 or consent of instructor.
- BIOSC 659 Systems Physiology 3(3,0)** Physiological systems of vertebrates and their homeostatic controls. Function of the major physiological systems is described in terms of anatomical structure and chemical and physical principles. *Preq:* One year each of biology, chemistry, and physics or consent of instructor.
- BIOSC 660 Systems Physiology Laboratory 2(1,2)** Modern and classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOSC 659. Students are introduced to computer-aided data acquisition and computer simulations of physiological function. *Preq or Coreq:* BIOSC 659.
- BIOSC 661 Cell Biology 3(3,0)** In-depth analysis of how and where intracellular and extracellular molecules control general and specific cellular functions such as gene expression, secretion, motility, signaling, cell-cycle control and differentiation. Taught and graded at a level where students are expected to infer from and integrate cellular events. *Preq:* BIOCH 301 or consent of instructor.
- BIOSC 662 Cell Biology Laboratory 2(1,2)** Accompanies BIOSC 661; focuses on molecular and microscopic analysis of eukaryotic cells. *Coreq:* BIOSC 661.
- BIOSC 664 Mammalogy 4(3,3)** Origin, evolution, distribution, structure, and function of mammals with laboratory emphasis on mammals of the Southeast. Field trips and live trapping of mammals are required. *Preq:* BIOSC 303 or consent of instructor.
- BIOSC (GEN, HORT) 665 Plant Molecular Biology 3(3,0)** See HORT 665.
- BIOSC 666 Evolution of Human Behavior 3(3,0)** Familiarizes students with the evolutionary basis of human behavior. Examines topics such as altruism, cooperation, mating systems, parental investment and social systems using diverse examples, from hunter-gatherer to technological societies. *Preq:* ANTH 351, BIOSC 335, 470, or PSYCH 201; or consent of instructor.

- BIOSC 668 Herpetology 3(2,3)** Systematics, life history, distribution, ecology, and current literature of amphibians and reptiles. Laboratory study of morphology and identification of world families and U.S. genera, as well as all southeastern species. Field trips are required. *Preq:* BIOSC 303 or consent of instructor.
- BIOSC (ENT, WFB) 669 Aquatic Insects 3(1,6)** See ENT 669.
- BIOSC 670 Behavioral Ecology 3(3,0)** Historical and modern developments in animal behavior emphasizing the evolutionary and ecological determinants of behavior. A synthesis of ethology and comparative psychology. *Preq:* BIOSC 302 or 303 or consent of instructor.
- BIOSC 671 Behavioral Ecology Laboratory 2(1,2)** Laboratory exercises that explore the behavior of animals. Emphasizes behavioral observation and analysis and presentation of findings in a report format. Includes a semester-long independent research project. *Preq or Coreq:* BIOSC 670 or consent of instructor.
- BIOSC 672 Ornithology 4(3,3)** Biology of birds: their origin and diversification, adaptations, phylogeny, classification, structure and function, behavior, ecology, and biogeography. Field identification is emphasized, and field trips are required. *Preq:* BIOSC 303 or consent of instructor.
- BIOSC 673 History of Modern Biology 3(3,0)** Examines the intellectual and social factors defining the study of life from the scientific revolution of the 1600s to the modern biological sciences. Investigates the historical origins of biological disciplines and explores the differing cultures, methodologies, and philosophical commitments of these communities. *Preq:* Introductory course in biology or consent of instructor.
- BIOSC 675 Comparative Physiology 3(3,0)** Physiological systems of invertebrates and vertebrates with emphasis on environmental adaptation. Physiological principles as they relate to metabolism, thermoregulation, osmoregulation, respiration, and neural and integrative physiology. *Preq:* One year each of biology, chemistry, and physics or consent of instructor.
- BIOSC 676 Comparative Physiology Laboratory 2(1,2)** Modern classical experimental methods demonstrate fundamental physiological principles discussed in BIOSC 475. Students are introduced to computer-aided data acquisition and manipulation as well as computer simulations of physiological function. *Preq or Coreq:* BIOSC 675.
- BIOSC 677 Ichthyology 3(2,3)** Systematics, life history, distribution, ecology, and current literature of fish. Laboratory study of morphology and identification of U.S. genera and all Southeastern species. Field trips are required. *Preq:* BIOSC 303 or consent of instructor.
- BIOSC (AVS) 680 Vertebrate Endocrinology 3(3,0)** Introduction to the basic principles of neuroendocrine integration and homeostatic maintenance in vertebrates. Comparative morphology and physiology of various endocrine tissues and hormone chemistry and modes of action are considered. *Preq:* BIOSC 303, organic chemistry or consent of instructor.
- BIOSC 681 Web Design for the Life Sciences and Agriculture 3(2,2)** Addresses basic principles and theories of Web design and site construction, including usability and accessibility considerations. Web and graphics design software are used to develop sites suitable for life science and agricultural organizations. Service-learning is used with student projects. *Preq:* AG ED 200, CP SC 120, or consent of instructor.
- BIOSC 684 Human and Comparative Vertebrate Embryology 3(3,0)** Study of human and comparative embryology with an introduction to related clinical correlations. Students develop an understanding of normal and abnormal human and comparative vertebrate embryonic development. *Preq:* BIOL 111 or consent of instructor.
- BIOSC 687 Electron and Optical Microscopy Theory 3(2,2)** Offers a theoretical and practical introduction to light and electron microscopy. Topics include Koehler illumination, polarization, interference, phase contrast, DIC epifluorescence, laser scanning light microscopy, SEM, TEM, EDS, ultramicrotomy, tomography, and digital imaging. *Preq:* Consent of instructor.
- BIOSC 730 SC Life: Topics for Teachers 3(2,2)** Topics relating to the SC Life curriculum. Lectures, laboratories, and extensive field studies focus on the natural history and biodiversity of South Carolina. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- BIOSC 731 SC Life: DNA Technology for Teachers 3(2,2)** Lectures and laboratories focus on application of DNA technology in society. Restricted to elementary, middle, and secondary school teachers. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- BIOSC 732 SC Life: Forensic Science Topics for Teachers 3(2,2)** Application of a broad spectrum of forensic science to answer questions of interest to the legal system. Lectures, laboratories, and field trips focus on different subdivisions of forensic science. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- BIOSC 733 SC Life: Technology Topics for Teachers 3(2,2)** Lectures and laboratories focus on ways to help teachers integrate technology into the classroom. Restricted to elementary, middle, and secondary school teachers. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- BIOSC 802 Conservation Genetics 3(3,0)** Introduction to theoretical population genetics and empirical studies of evolutionary genetics. Emphasizes exploring conservation genetics issues from an applied perspective by doing exercises using real data sets and population genetics analyses programs as well as discussions of empirical studies of species of conservation concern. *Preq:* BIOSC 335, GEN 300 or 302, or consent of instructor.
- BIOSC 803 Population Dynamics 4(2,6)** Fundamental mechanisms basic to regulation of natural animal populations. Laboratory research project in population dynamics complements theory.
- BIOSC 810 Behavioral Ecology 3(3,0)** Behavior of animals and the ecological context in which various behaviors are shown; empirical and theoretical aspects of behavioral ecology at individual, population, and community levels. *Preq:* BIOSC 441 and 470 or consent of instructor.
- BIOSC (ENTOX) 811 Immunotoxicology 3(3,0)** See ENTOX 811.
- BIOSC 812 Seminar 1(1,0)** Review and presentation of current literature in biological sciences. May be repeated for a maximum of four credits. To be taken Pass/Fail only. *Preq:* Consent of instructor.
- BIOSC 816 Advanced Ecosystem Analysis 4(3,3)** Description and analysis of ecological systems; biogeochemical, physicochemical, and ecological principles emphasizing fundamental unity of ecosystems and their abiotic environment. Laboratory focuses on application of theory to actual field and laboratory research problems. *Preq:* BIOSC 641, MTHSC 210, 605, or consent of instructor.
- BIOSC 820 Community Ecology 3(3,0)** Examines species interactions in plant and animal communities and uses experimental, observational, and theoretical approaches to study competition, predation, facilitation, habitat selection, and succession. Emphasizes how species diversity is maintained and the consequences of diversity at local and regional scales. *Preq:* BIOSC 441 or equivalent.
- BIOSC 825 Comparative and Veterinary Immunology 3(3,0)** Survey of the evolutionary relationships, the physiology, and the cellular/molecular biology of the immune systems of animals; demonstrations that focus on those animals having high economic input, biomedical importance, or a key ecological position; current research with a historical perspective. *Preq:* AVS 825, MICRO 614, or consent of instructor.
- BIOSC (ENTOX) 830 Mechanistic Toxicology 3(3,0)** See ENTOX 830.
- BIOSC (ENTOX) 831 Biomarkers in Toxicology 3(1,6)** See ENTOX 831.
- BIOSC (ENTOX) 854 Aquatic Toxicology 3(3,0)** See ENTOX 854.
- BIOSC 863 Special Problems 1-4** Research not related to thesis. *Preq:* Consent of instructor.
- BIOSC 871 Selected Topics 1-4(1-4,0)** Cellular and developmental biology, ecology, behavior, evolutionary biology, molecular biology, physiology, systematics, and other topics of interest to graduate students in the biological sciences. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- BIOSC 872 Selected Topics Laboratory 1-4(0,2-8)** Specialized laboratory experiences in cellular and developmental biology, ecology, behavior, evolutionary biology, molecular biology, physiology, systematics, and other topics of interest to graduate students in the biological sciences. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.

BIOSC 888 Electron and Light Microscopy Practicum 3(1,5) Continuation of BIOSC 687, offering graduate students practical training on light and electron microscopes. Proficient students become approved end users by performing approved, independent imaging projects. *Preq:* BIOSC 687 and consent of instructor.

BIOSC 891 Master's Thesis Research 1-12

BIOSC 991 Doctoral Dissertation Research 1-12

BIOMOLECULAR ENGINEERING

BMOLE 603 Biotransport Phenomena 3(3,0)

Analysis of single and multidimensional steady-state and transient problems in momentum, mass, and energy transfer in biological systems. Mathematical similarities and differences in these mechanisms are stressed, and mathematical descriptions of physiological and engineering systems are formulated. *Preq:* CHE 330, MTHSC 208.

BMOLE 623 Bioseparations 3(3,0)

Study of principal methods of separation and purification of bioproducts, such as proteins, amino acids, and pharmaceuticals. Topics include analytical bioseparations, membrane separations, sedimentation, cell disruption, extraction, adsorption, chromatography, precipitation, crystallization, and drying. *Preq:* BIOCH 301, 305, or 423; CHE 330, or consent of instructor.

BMOLE 625 Biomolecular Engineering 3(3,0)

Introduction to basic principles of biomolecular engineering: the purposeful manipulation of biological molecules and processes applied to problems and issues in the life sciences, biotechnology, and medicine. Topics include carbohydrates, proteins, nucleic acids, and lipids with emphasis on their structure-property-function relations; molecular recognition; biochemical pathway engineering; and cell growth. *Preq:* CHE 230 and 319 or consent of instructor.

BMOLE 626 Biosensors and Bioelectronic Devices 3(3,0)

Development of methodologies used to design, fabricate, and apply biosensors and bioelectronic devices for the environmental, medical, and chemicals industries. Application of the fundamentals of measurement science to optical, electrochemical, mass, and thermal means of signal transduction. Use of the fundamentals of surface science to interpret bio-immobilization and biomolecule-surface interactions. *Preq:* CHE 330, and BIOCH 301 or 305, or consent of instructor.

BMOLE 627 Membranes for Biotechnology and Biomedicine 3(3,0)

Students learn principles of membrane science and technology and study membrane applications in the biotechnology and biomedical industries. Advanced topics include surface modification of membranes, synthesis of porous membranes for biomedical applications such as tissue engineering, environmentally responsive membranes, and membrane-based biomedical devices. *Preq:* CHE 330 or equivalent or consent of instructor.

BMOLE 810 Biosensors and Bioelectronic Devices 3(3,0) Study of methodologies in design, fabrication, and application of biosensors and bioelectronic devices for monitoring the environmental, medical, and chemical industries. Includes measurement science fundamentals applied to optical, electrochemical, mass, and thermal means of signal transduction. Also considers surface science fundamentals to interpret bioimmobilization, biofouling, and nonspecific interactions of enzymes, antibodies, and DNA at surfaces. *Preq:* Consent of instructor.

BIOSYSTEMS ENGINEERING

B E (CSENV) 608 Land Treatment of Wastewater and Sludges 3(3,0) See CSENV 608.

B E 612 Heat and Mass Transport in Biosystems Engineering 3(3,0)

Fundamentals of heat and mass transport used in engineering design and analysis of biological systems; principles of steady state and transient energy and mass balances including chemical and biological generation terms. *Preq:* B E 312, MTHSC 208. *Coreq:* M E 310.

B E 614 Biosystems Engineering Unit Operation 3(2,3)

Applies the basic principles of statics, dynamics, and thermodynamics to design of mechanical and electrical systems supporting biological operations and processes. *Preq:* B E 314, M E 310.

B E 615 Instrumentation and Control for Biosystems Engineers 4(3,3)

Overview of modern instrumentation techniques and digital electronic components and subsystems to integrate them into digital data acquisition and control systems for biosystems. Emphasizes laboratory use of equipment. Topics include characteristics of instruments, signal conditioning, transducer theory and applications, programmable logic controllers, and digital data acquisition and control. *Preq:* E C E 307.

B E 617 Applied Instrumentation and Control for Biosystems 2(1,3)

Study of hardware and software implementation of digital data acquisition and control systems for application to agriculture, aquaculture, biotechnology, and other biosystems. Topics include digital electronic circuits and components, microcomputer architecture, interfacing, and programming. *Preq:* B E 415 or consent of instructor.

B E 622 Hydrologic Modeling of Small Watersheds 3(3,0)

Design of structures and development of best management practices for runoff, flood, and sediment control from rural and urban areas, including natural and disturbed watersheds. Topics include modeling of prismatic and non-prismatic channels, culverts, and detention/retention ponds. *Preq:* B E 322 or consent of instructor.

B E (CHE) 628 Biochemical Engineering 3(3,0)

Use of microorganisms and enzymes for the production of chemical feedstocks, single-cell protein, antibiotics, and other fermentation products. Topics include kinetics and energetics of microbial metabolism, design and analysis of reactors for microbial growth and enzyme-catalyzed reactions, and considerations of scale-up, mass transfer, and sterilization during reactor design. *Preq:* B E 312, MICRO 305; *Coreq:* (for Biosystems Engineering majors) BIOCH 301 or 305; (for Chemical Engineering majors) CHE 330, 450.

B E 635 Applications in Biotechnology Engineering 3(2,3) Bioengineering principles applied to the expanding fields of agricultural biotechnology, ecotechnology, and biomedical technology. Special applications include waste treatment and ecological engineering, bioreactor propagation of plant and animal cells and tissues, applied genomics and synthetic seed production, biosensors and biomonitoring, biological implants and materials biocompatibility. *Preq:* B E (CHE) 428.

B E 638 Bioprocess Engineering Design 3(2,2)

Design and analysis of systems for processing biological materials. Topics include biotechnology, thermodynamics, transport processes, and biological properties related to bioprocess design and computational simulation. Unit operations include basic bioreactor operation, bioseparations, and preservation techniques. *Preq:* B E 428.

B E 640 Renewable Energy Resource Engineering 3(2,2)

Investigation into emerging renewable energy resources, including detailed study of solar, wind, and bioenergy alternatives. Also includes principles, technologies, and performance evaluation of components for these technologies and an introduction to tidal, hydro, geothermal, and other energy; energy conservation; cogeneration; financial, economical, and other issues related to alternative energy sources. *Preq:* Science or engineering major, consent of instructor.

B E 642 Properties and Processing of Biological Products 2(1,3)

Study of engineering properties of biological materials and their uniqueness as design restraints on systems for handling, processing, and preserving biological products. *Preq:* B E 333, C E 341, M E 302, 310.

B E (EE&S, FOR) 651 Newman Seminar and Lecture Series in Natural Resources Engineering 1(0,2)

Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/or resource conservation issues are addressed. *Preq:* Senior standing, consent of instructor.

B E 664 Non-Point Source Management in Engineered Ecosystems 3(2,3)

Fundamentals of non-point source pollution including quantification of environmental impact and ecosystem management related to contaminants and nutrients and to planning and design of ecological systems. *Preq:* MICRO 305, senior standing in engineering, or consent of instructor.

B E (EE&S) 684 Municipal Solid Waste Management 3(3,0) See EE&S 684.

B E 781 Special Problems 1-3(1-3,0)

Students select subjects and conduct library, laboratory, and/or field research. A technical report documenting the study is required. May be repeated for a maximum of six credits. *Preq:* Master's degree candidate in Engineering.

B E 835 Industrial Biotechnology Techniques 4(3,3)

Introduces industrial biotechnology techniques with emphasis on bioproduction, pilot bioprocessing equipment operation, biopharmaceutical storage, process simulation and economics, project management, good laboratory practice (GLP), and current good manufacturing practice (cGMP) geared toward the biotechnology industry. *Preq:* B E 638 or BIOCH 633, GEN (BIOSC) 616, or consent of instructor.

B E 838 Advanced Bioprocess Engineering 3(3,0) Advanced bioprocessing techniques with emphasis on processing and modeling aspects of eukaryotic systems and associated bioproducts. Modules include thermal processing, supercritical fluid extraction, and advanced biological thermodynamics, chromatography, and spectroscopy. *Preq:* B E 438/638 or consent of instructor.

B E 865 Advanced Biological Transport Processes 3(3,0) Study of transient transport processes in biological materials and systems. Incorporates mathematics describing active and passive cellular transport. Emphasizes numerical solution techniques for coupled transport relationships in nonideal, heterogeneous systems, including biological kinetic and thermodynamic considerations. *Preq:* BIOCH 305, CH E 601, MTHSC 634, or consent of instructor.

B E 871 Selected Topics in Biosystems Engineering 1-3(1-3,0) Supervised, in-depth study of an area related to biosystems engineering not covered in other courses. May be repeated for a maximum of six credits.

B E 891 Master's Thesis Research 1-12

B E 901 Special Problems in Agricultural Engineering 3(3,0) Library and/or laboratory research on one of the following subjects, depending on student's field of study or interests: power and machinery, soil and water resources, farm structures, electric power and processing, food engineering, forest engineering or waste management. A technical report is required.

B E 991 Doctoral Dissertation Research 1-12

BOTANY

BOT 821 Inorganic Plant Metabolism 3(3,0) Study of plant, soil, water, and nutrient relations. Topics include permeability, uptake and translocation, transpiration, and mineral nutrition. Offered fall semester of odd-numbered years only. *Preq:* BIOSC 601 and 602 or consent of instructor.

BOT 822 Organic Plant Metabolism 3(3,0) Discusses respiration and photosynthesis; synthesis, translocation, storage, transformation, and degradation of organic materials, fats, carbohydrates, proteins, pigments, and nucleic acids. Offered spring semester of even-numbered years only. *Preq:* BIOSC 601 and 602 and BIOCH 623 or consent of instructor.

BOT 823 Plant Growth and Development 3(3,0) Considers vegetative and reproductive growth and development from seed to maturity, flowering, fruiting and senescence; natural and synthetic growth regulators; and morphogenesis. Offered fall semester of even-numbered years only. *Preq:* BIOSC 601, 602, and organic chemistry; or consent of instructor.

BOT 824 Mode of Action of Growth Substances 4(3,3) Study of the physiology and biochemistry of both natural and synthetic growth regulators, hormones, growth retardants, herbicides, and other inhibitors. Considers methodology and mechanism of action. Offered spring semester of odd-numbered years only. *Preq:* BIOSC 601 and 602 and general biochemistry or BOT 822 or consent of instructor.

BOT 831 Advanced Plant Taxonomy 4(3,3) Study of the principles of plant classification including relationships and characteristics of major groups of vascular plants. Students collect and identify spring flora of the area. Offered spring semester of odd-numbered years only. *Preq:* BIOSC 606 or consent of instructor.

BOT 850 Plant Tissue and Cell Culture 3(2,3) Methods and principles of plant tissue and cell culture: cloning, embryogenesis, protoplast fusion, plant regeneration, potential of plant genetic engineering. Offered fall semester of odd-numbered years only. *Preq:* Introductory plant physiology or consent of instructor.

BOT 860 Plant Anatomy and Cell Biology 4(3,3) Covers the subcellular structure and the comparative organization and function of plant cell-types, tissues, and organs. Emphasizes the interplay between the environment and the plant body and among genomes, membrane compartments, and the cytoplasm as these relate to the highly orchestrated stages in development. Offered spring semester of even-numbered years only.

BUSINESS ADMINISTRATION

M B A 802 Managerial Economics 3(3,0) Functioning of the market economy emphasizing the role of prices in determining the allocation of resources; the functioning of the firm in the economy and forces governing the production of economic goods. Emphasis is on using economic analysis in managerial decision making. *Preq:* M B A 803 or equivalent or consent of instructor.

M B A 803 Statistical Analysis of Business Operations 3(3,0) Provides breadth and depth in the application of statistical techniques building on basic statistical knowledge gained in M B A 818. Topics include analysis of variance, simple and multiple regression analysis, forecasting, and nonparametric statistics. *Preq:* M B A 818 or equivalent or consent of instructor.

M B A 804 Managerial Accounting and Information Systems 3(3,0) Preparation, analysis, interpretation, and use of accounting information in the guidance and control of a business enterprise. Case material and problems are used. *Preq:* M B A 819 or equivalent or consent of instructor.

M B A 805 Enterprise, Government, and the Public 3(3,0) Regulatory environment of business and how it evolves. Through use of economic logic and business cases, students are equipped to understand the all-pervading nature and importance of government regulation in the economy.

M B A 806 Operations Management 3(3,0) How firms create value and how decisions in the areas of capacity, facilities, technology, vertical integration, workforce, quality, production planning/materials control, and organization influence a firm's ability to add value; decisions and analysis tools used for these decisions. *Preq:* M B A 818 and 830, or equivalent, or consent of instructor.

M B A 807 Financial Management 3(3,0) Theory of financial management as it relates to the financial problems faced by business concerns. Concepts developed are used to assess the validity of emerging formalized techniques for improving decision making in the financial area. Topics include financial planning, short- and long-term fund raising, capital budgeting, the administration of working capital, recapitalization, listing of securities, and reorganization. Case material and problems are used. *Preq:* M B A 804 or 854 or equivalent, and M B A 803 or 853 or equivalent.

M B A 808 Managerial Problems in Marketing 3(3,0) Major decisions facing marketing executives and top management in their attempt to harmonize the objectives and resources of the organization with the opportunities found in the marketplace; recent theoretical developments in marketing and related disciplines and their application in management. Readings, case analysis, and discussions are used. *Preq:* M B A 829 or equivalent and M B A 803, 804, 807; or consent of instructor.

M B A (MGT) 809 Organizational Behavior and Human Resources Management 3(3,0) Theories and models of behavior; human resources management concepts and processes as they apply to managing individual and work-group behavior in organizations. Organizational behavior topics include leadership, motivation, and teamwork. Human resource management topics include human resources strategy, selection, performance evaluation, reward systems, and employee development.

M B A 810 Managerial Policy 3(3,0) Decisions involved in the establishment of managerial policy. Includes analysis and discussion of problems, resources, and alternative courses of action relative to the selection of company objectives and the most feasible means for achieving company goals. Integrates material and treats the coordination of the affairs of the firm as a whole. Case studies are emphasized. Should be completed as the final course in the program. *Preq:* M B A 806, 807, 808, 809.

M B A 811 International Business Management 3(3,0) Survey and analysis of managerial theory and the practice of international business, including the influence of cultural, economic, political, and financial factors affecting the management of the firm. Case studies of companies engaged in international business are discussed.

M B A 812 Financial Markets and Institutions 3(3,0) Topics critical to the proper management of financial institutions including financial regulations, financial security types and their yields, interest rate theories, interest rate risk management, foreign currency risk management, stock index futures, and numerous operating functions in banking. *Preq:* M B A 807 or consent of instructor.

M B A 814 Directed Research in Quantitative Analysis 3(3,0)

M B A 815 Directed Research in Qualitative Analysis 3(3,0)

- M B A 817 Business Forecasting Techniques and Applications 3(3,0)** Study of forecasting techniques and their application for developing and assessing forecasts. Topics include economic data sources, multiple regression and time series analysis, and interpretation of forecasts for management and other clients. *Preq:* M B A 802 and 803, or equivalent.
- M B A 818 Introduction to Business Statistics 2(2,0)** Introduction to probability concepts and distributions, sampling, estimation, and hypothesis testing involving one and two populations. May not be taken for credit toward any graduate degree. *Preq:* Consent of MBA director.
- M B A 819 Introduction to Accounting and Finance 3(3,0)** Basic concepts of accounting and finance with emphasis on using financial data for decision making; measuring, processing, reporting, and analysis of financial information; use of discounted cash flow analysis in valuation and the measurement of risk and return. Designed for MBA students lacking background in accounting and finance. *Preq:* Consent of MBA director.
- M B A (MKT) 826 Business Marketing 3(3,0)** Strategic marketing as it applies to industrial, organizational, and institutional markets; consumer marketing versus business-to-business marketing; current business marketing literature and practices. *Preq:* Principles of marketing or equivalent or consent of instructor.
- M B A (MKT) 828 Services Marketing 3(3,0)** Nature of services marketing and the special requisites that distinguish successful services marketing from goods marketing. Topics include promoting and making the service tangible, designing optimal service operations, the ideal service worker, pricing of services and critical points of services delivery. *Preq:* Principles of marketing or equivalent or consent of instructor.
- M B A 829 Marketing Foundations 2(2,0)** Principles and concepts involved in planning, pricing, promoting, and distributing goods and services. *Preq:* Consent of MBA director.
- M B A 830 Managerial Decision Modeling 2(2,0)** Introduction to basic decision modeling techniques useful in managerial decision making, including linear programming, project management, and Monte Carlo simulation. May not be taken for credit toward any graduate degree. *Preq:* Consent of MBA director.
- M B A (FIN) 832 International Financial Management 3(3,0)** Factors that influence the financial management of multinational corporations. Topics include international parity conditions, currency exposure management, capital budgeting of international projects and political risks. *Preq:* M B A 807 or 857 or consent of instructor.
- M B A 833 Real Estate Investments 3(3,0)** Study of real estate investment analysis and decision making featuring the use of the discounted cash flow model and other tools to evaluate investment alternatives from the perspective of an equity real estate investor. Emphasizes market analysis, ownership alternatives, and financing considerations. *Preq:* M B A (FIN) 836.
- M B A 835 Investment Management 3(3,0)** Discusses current techniques and strategies in the analysis of various investment alternatives. Includes portfolio management with an introduction to options and futures markets. *Preq:* Principles of accounting and a demonstrated proficiency in basic finance.
- M B A (FIN) 836 Real Estate Principles 3(3,0)** Advanced survey course to acquaint students with the theories, practices, and principles of real estate. Topics include urban economics, real estate law, brokerage, real estate valuation, financial institutions, tax issues, investment analysis, and development. *Preq:* M B A 807 or 819 or consent of instructor.
- M B A 837 Legal Environment of Business 2(2,0)** Legal and case analysis of court systems and dispute resolution, contracts, business torts, EEOC, Age Discrimination in Employment Act, Americans with Disabilities Act, Employment-at-Will compared to union participation; international legal considerations as these topics relate to business concerns. May not be used for credit toward a graduate degree. *Preq:* Consent of MBA director.
- M B A 838 Law in the Business Environment 1(1,0)** Legal analysis of contracts, business torts, EEOC, American Discrimination in Employment Act, Americans with Disabilities Act, Employment-at-Will as compared to union participation and an overview of international legal considerations as these topics relate to business concerns. *Preq:* Consent of MBA director.
- M B A 839 Business Negotiations and Legal Dispute Resolution 3(3,0)** Negotiation and dispute resolution in the business environment. Negotiation techniques and practices, negotiation team building, international negotiation issues, as well as alternative dispute resolutions as applied to legal issues within the business environment. *Preq:* M B A 837, 838 or consent of instructor.
- M B A 841 Real Estate Finance 3(3,0)** The application of financial analysis and theory to real estate, mortgage credit analysis, and current financing techniques for residential and commercial properties is emphasized. Topics include financial institutions, mortgage financing techniques, financial decisions, and construction financing. *Preq:* M B A (FIN) 836.
- M B A 842 Real Estate Valuation 3(3,0)** Study of real estate appraisal with primary emphasis on two student projects: a house appraisal and a commercial property appraisal. Topics include highest and best use analysis, the three approaches to value, advanced capitalization techniques, discounted cash flow analysis, and the standards of professional practice. *Preq:* M B A (FIN) 836.
- M B A (MGT) 845 Technology and Innovation Management 3(3,0)** Interdisciplinary examination of problems and issues in integrating technology and innovation into processes and products; evaluating tangible and intangible aspects of new technology adoption; management research and development; and functional integration of marketing and operations.
- M B A 846 Use of Derivatives in Financial Engineering 3(3,0)** The valuation and use of basic derivative securities such as futures and options; the financial engineering of securities combinations such as swaps, spreads, and straddles; applications of derivatives and financial engineering in managing financial risks. *Preq:* M B A 807 or 867 or consent of instructor.
- M B A 850 Business Communications 1(1,1)** Techniques, skills, problems, and approaches for effective business communications; strengths and weaknesses of various communications forms with concentration on informative and persuasive models. Includes practical experience in written work and presentations, video and verbal feedback, teamwork, problem solving, and situational presentations. *Preq:* Consent of MBA director.
- M B A 853 Statistical Analysis for Business 3(3,0)** Application of modern statistical inference in business operations. Topics include testing statistical hypotheses, consequences of making decisions with incomplete information, univariate and multivariate regression with emphasis on business applications and design of experiments and analysis of variance. Special attention is given to efficient and relevant data collection and interpretation. Offered fall semester only. *Preq:* Consent of MBA director.
- M B A 854 Managerial Accounting 3(3,0)** Analysis, interpretation, and use of accounting information for planning and control in business and nonbusiness organizations. Includes profit planning, budgeting and standards; product and segment costing and evaluation; and case studies and computer-based assignments. Offered spring semester only. *Preq:* M B A 819 or equivalent or consent of instructor.
- M B A 856 Operations Management 3(3,0)** Strategic and tactical issues involved in the design, planning, and control of the operating system in service and manufacturing organizations. Topics include operations strategy, process choice, facility design, planning and scheduling, and methods for continuous improvement. Offered spring semester only. *Preq:* M B A 853 or consent of instructor.
- M B A 858 Managerial Marketing 3(3,0)** Key marketing concepts and theories with extensive application to a broad range of business and not-for-profit situations; analysis of marketing opportunities and threats, researching and selecting target markets, and developing and comparing marketing strategies to prepare students to develop advanced marketing strategies. Offered fall semester only. *Preq:* M B A 853 or consent of instructor.
- M B A 859 Management Science Applications 3(3,0)** Management science techniques and their application to a wide range of managerial decisions. Topics include queuing models, linear programming, transportation problems, and simulation. *Preq:* Consent of MBA director.
- M B A 860 Advanced Marketing Strategy 3(3,0)** Advanced marketing theory and critical thinking skills applied to support strategic decision making. Data analysis and advanced marketing models are employed with emphasis on building analytic and assessment skills. Offered spring semester only. *Preq:* M B A 858 or MKT 865 or consent of instructor.

M B A (MGT) 861 Information Systems 3(3,0)

The critical role of information systems in contemporary business organizations; key information systems and technologies; their impacts both within and across organizational settings.

M B A 862 Managerial Economics 3(3,0)

Use of economic analysis in managerial decision making. Topics include the theory of cost, production, industrial organization, coordination, and control of the firm, from theoretical concepts to actual decision making. Offered fall semester only. *Preq:* Consent of MBA director.

M B A 863 Advanced Managerial Economics 3(3,0)

Advanced economic analysis for managerial decision making. Topics include advanced price theory, theory of firm, internal organization of the firm, the economics of strategic behavior in the market, and the empirical estimation of demand and cost functions. *Preq:* M B A 862 or consent of instructor.

M B A 870 Strategic Management 3(3,0)

Investigation of the ongoing process of positioning a firm for competitive advantage in its changing business environment focusing on the role of general managers in formulating and implementing strategies for single and multibusiness firms. Business cases, class discussions, and group projects are used to integrate content from previous business courses. Offered spring semester and summer session only. *Preq:* M B A 807, 809, 838, 854, 856, 861, 862; or consent of instructor.

M B A 871 Programming and System Development 3(3,0)

Programming concepts and structures in developing information systems applications. Specific techniques and tools covered are updated to incorporate the newest technologies. *Preq:* Consent of instructor.

M B A 872 Entrepreneurial Finance 3(3,0)

Topics include business valuation, financial forecasting, financing strategies, and business harvesting. Includes case studies and computer modeling. *Preq:* ECON 855 or M B A 807.

M B A (MGT) 874 Managing Continuous Improvement 3(3,0)

How to initiate and lead change toward a total quality environment; basic tools of quality management; use of teams to achieve change; quality function deployment; ISO 9000; supplier development; and use of survey methods to track progress of change. *Preq:* MGT 803 or consent of instructor.

M B A 875 Enterprise Development 3(3,0)

Studies the entrepreneurial process from conception to birth of new venture emphasizing discovery, searching for opportunities, and gathering resources to convert opportunities to businesses. Students learn how to evaluate entrepreneurs and their plans by working in teams to write a business plan for a new venture.

M B A 876 Electronic Marketing 3(3,0)

Application of the concepts and theories of marketing to e-commerce, challenges facing marketing in business-to-business and business-to-consumer contexts, strategic application of marketing mix variables in e-business environment. *Preq:* Consent of instructor.

M B A 880 MBA Seminar 1-3(1-3,0) Discussion of topics in professional development for MBA students through workshops and other activities. May be repeated for a maximum of four credits. To be taken Pass/Fail only. *Preq:* Consent of instructor.

M B A 888 Internship in Business Administration 1-3

Preplanned, preapproved, faculty-supervised internship designed to give students on-the-job learning in support of classroom education. Internships must be no less than ten full-time, consecutive weeks with the same internship provider. May be repeated for a maximum of three credits. *Preq:* Thirty semester hours of graduate credit and consent of MBA director.

M B A 899 Selected Topics in Business Administration 3(3,0)

Current topics in business administration as they relate to the manager. Topics may come from a single functional area or may integrate two or more functional areas (accounting, economics, finance, management, or marketing). May be repeated for a maximum of nine credits.

CAREER AND TECHNOLOGY EDUCATION

CTE 610 Selected Topics 1-3(1-3,0)

Subject areas organized according to program needs. Content is planned cooperatively by the University and the school system or agency requesting the course. May be repeated for a maximum of 18 credits, but only if different topics are covered. *Preq:* Consent of instructor.

CTE 613 Contemporary Technological Problems 3(3,0)

Provides students with an understanding of the problems and contributions of technology. Examples of these relationships are taken from historical accounts and from analyses of contemporary technological intervention both in industrialized and nonindustrialized countries.

CTE 615 History and Philosophy of Career and Technology Education 3(3,0)

Study of career and technology education programs with the intent of developing a sound individual philosophy. General topics include history, local, state, and federal legislation; types of career and technology programs; professional organizations and career guidance.

CTE 620 Manufacturing II: Computer-Integrated Manufacturing 3(2,3)

Study of computer-integrated manufacturing and its related concepts, including robotics, computer numeric control, electronic pneumatic and sensor systems, programmable logic controllers, and ancillary devices. *Preq:* CTE 220 or consent of instructor.

CTE 630 Construction Technology II: Practices and Systems 3(2,3)

Study of industrial practices and systems affecting man, materials, and equipment associated with construction industries. Activities are directed toward developing a working knowledge of construction technology and a framework for incorporating this instruction into programs in the public and private sectors. *Preq:* CTE 230.

CTE 640 Power Technology II: Transmission and Control Systems 3(2,3)

Continuation of CTE 240. Instruction in transmitting and controlling power for utilization in such areas as manufacturing, communications, construction, and transportation. Introduces concepts of automation and robotics to enable classroom teachers and industry personnel to gain necessary insights into this important area of technology. *Preq:* CTE 240.

CTE 660 Developing Training Programs for Industry 3(3,0)

Identification, selection, and organization of subject matter for industrial training programs. Emphasizes analysis techniques, session and demonstration planning, written instructional materials development, trainee evaluation, and planning instructional schedules. *Preq:* Senior standing in Career and Technology Education or consent of instructor.

CTE 665 Conducting and Evaluating Training Programs 3(3,0)

Basic concepts of supervision, administration, and management of training programs. Emphasis is on determining training requirements, planning, directing, and evaluating training programs. *Preq:* CTE 160, 460 or consent of instructor.

CTE 668 Public Relations 3(3,0)

Emphasizes techniques and methods of effective public and industrial relations which contribute to understanding and cooperation of labor, business, professional, educational, and industrial groups.

CTE 670 Course Organization and Evaluation 3(3,0)

Problems, techniques, and procedures in the preparation, selection, and organization of subject matter for instructional purposes. Methods, techniques, and preparation of materials used in the evaluation of student achievement in industrial education subjects.

CTE 671 Teaching Career and Technology Education 3(3,0)

Effective methods for teaching and training in career and technology education. Emphasis is given to class organization, preparation of lesson outlines, and audio-visual aids. *Preq:* ED F 335.

CTE 673 Assessment in Career and Technology Education 3(3,0)

Study of competency testing in career and technology education which includes educational objectives and measurement; construction and use of oral, objective, short answer, matching, essay, and performance tests; and treatment of test data for grade assignments and statistical analysis.

CTE (AG ED, ED F) 680 Educational Applications of Microcomputers 3(2,2)

See ED F 680.

CTE (AG ED, ED F) 682 Advanced Educational Applications of Microcomputers 3(2,2)

See ED F 682.

CTE 683 Architectural Drafting for Career and Technology Education 3(1,6)

Study of the major aspects of architectural drawing such as plot, floor, and foundation plans; wall sections; and elevations. *Preq:* CTE 180.

- CTE 684 Communications Technology II: Systems 3(2,2)** Continuation of CTE 280. Includes theory and operation of communications systems: telegraph, telephone, radio, television, satellites, sound/video recorders, lasers, and computers. Instruction on strategies for interpreting this area of technology to trainees and students is emphasized. *Preq:* CTE 280.
- CTE 686 Instructional Media Development 3(1,4)** Basic instructional media development techniques. Students develop material using authoring software such as HyperCard, transparencies using Persuasion and/or PowerPoint, and fully storyboarded, scripted, and edited digital as well as analog video.
- CTE 692 Advanced Projects 1-6** Students gain depth in content by completing projects under the supervision of an instructor in career and technology education. Written project approval is required before registering. May be repeated twice for a maximum of six credits. *Preq:* Consent of instructor.
- CTE (ED) 700 Supervising the Student Teacher in the Public School 2-3(2-3,0)** See ED 700.
- CTE 815 Seminar in Industrial Education 1(1,0)** Students and faculty discuss and study new technological and professional advances. May be repeated for a maximum of three credits. To be taken Pass/Fail only.
- CTE 820 Recent Process Developments 3(3,0)** Study of recent technological innovations, inventions, processes, and products and their impact on our industrial, labor, educational, and social institutions.
- CTE (H R D) 845 Needs Assessment for Education and Industry 3(3,0)** See H R D 845.
- CTE (H R D) 846 Applied Public Relations 3(3,0)** See H R D 846.
- CTE (H R D) 847 Instructional Systems Design 3(3,0)** See H R D 847.
- CTE 851 Current Topics in Communication Technology 1-3(1-3,0)** Recent technological processes in the communication industry such as CAD, desktop publishing, and interactive video for teachers and industrial personnel.
- CTE 852 Current Topics in Manufacturing Technology 1-3(1-3,0)** Contemporary manufacturing practices for public school teachers and industry personnel.
- CTE 853 Current Topics in Construction Technology 1-3(1-3,0)** Update for teachers in industrial technology education programs at the secondary level, instructors in construction-related programs at the postsecondary level, and industrial trainers in the private sector; contemporary technological processes in construction industries.
- CTE 854 Current Topics in Power Technology 1-3(1-3,0)** Contemporary applications of power and energy for public school teachers and industry personnel.
- CTE (H R D) 860 Instructional Materials Development 3(3,0)** See H R D 860.
- CTE 865 American Industries 3(3,0)** Concepts and principles of American industry and technology. Industrial plant visits supplement study of industrial organization, economics, management, production, and products.
- CTE (H R D) 870 Consulting for Education and Industry 3(3,0)** See H R D 870.
- CTE (AG ED, ED) 889 Research in Education 3(3,0)** See AG ED 889.
- CTE 894 Project Research 1-6(1-6,0)** Research related to departmental projects. Open only to students planning to pursue advanced graduate study. Joint use with CTE 895, 896 is not permitted for degree.
- CTE 895 Special Problems I 3(3,0)** Special problems in industrial education varying with interests, experiences, and needs of students. *Preq:* Submission of a written proposal, completion of nine hours in the major, and consent of advisor.
- CTE 896 Special Problems II 3(3,0)** Continuation of CTE 895. *Preq:* CTE 895, written proposal, and consent of advisor.

CERAMIC AND MATERIALS ENGINEERING

C M E 602 Solid State Materials 3(3,0) Discussion of the properties of solids as related to structure and bonding with an emphasis on electronic materials. Band structure theory, electronic and optical properties are treated. *Preq:* C M E 326, MTHSC 208, PHYS 221.

C M E (BIO E) 615 Research Principles and Concepts 1(1,0) See BIO E 615.

C M E 616 Electrical Properties of Materials 3(3,0) Covers a range of topics dealing with electrical and magnetic materials. Topics include metal and polymer conductors, insulators, ceramic and polymer materials for dielectric applications, and ferroelectric, piezoelectric, pyroelectric, and electrooptic materials. Metal and ceramic magnetic materials are also discussed.

C M E 622 Mechanical Behavior of Materials 3(3,0) Covers the microstructural basis of deformation and fracture in ceramic, metallic, and polymeric systems. *Preq:* E M 201, MTHSC 208, or consent of instructor.

C M E 624 Optical Materials and Their Applications 3(3,0) Introduces the interaction of materials with light. Specific topics include fundamental optical properties, materials synthesis, optical fiber and planar waveguides, and the componentry and systems-level aspects of optical communication systems. *Preq:* C M E 402, 413.

C M E 690 Special Topics in Ceramic Engineering 1-3(1-3,0) Study of topics not ordinarily covered in other courses. Taught as the need arises. Typical topics could include current research in a specific area or technological advances. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

C M E 809 High-Temperature Materials 3(3,0) Properties of oxides, carbides, nitrides, borides, and silicides; obtainment and measurement of high temperatures; measurement of properties at high temperatures.

C M E 815 Colloidal and Surface Science 3(3,0) Theory and application of colloidal and surface chemistry to ceramic materials and processes.

C M E 816 Constitution and Structure of Glasses 3(3,0) Modern concepts of glass structure and properties.

C M E 821 X-Ray Diffractometry 3(2,3) Theory and application of powder X-ray diffractometry to ceramic and materials problems.

C M E 822 Scanning Electron Microscopy 3(2,3) Theory and application of scanning electron microscopy to ceramic and materials problems.

C M E 823 Transmission Electron Microscopy 3(2,3) Advanced course in electron microscopy for materials science incorporating all aspects of transmission techniques: basics, diffraction, imaging, and spectrometry. *Preq:* C M E 821 and 822 or consent of instructor.

C M E 825 Magnetic and Electrical Ceramic Materials 3(3,0) Application of magnetic and electrical theory to ceramic insulators, semiconductors, and ferroelectric and ferromagnetic products.

C M E 890 Selected Topics 1-3(1-3,0) Topics not covered in other courses emphasizing current literature and results of current research. Topics vary from year to year to keep pace with developments. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

CHEMICAL ENGINEERING

CH E 601 Transport Phenomena 3(3,0) Mathematical analysis of single and multidimensional steady-state and transient problems in momentum, energy, and mass transfer. Both the similarities and differences in these mechanisms are stressed. *Preq:* CH E 312, MTHSC 208.

CH E 612 Polymer Engineering 3(3,0) Design-oriented course in synthetic polymers. Topics include reactor design used in polymer production, effect of step versus addition kinetics on reactor design, epoxy curing reactions, polymer solubility, influence of polymerization and processing conditions on polymer crystallinity. *Preq:* CH 224 and 332 or consent of instructor.

CH E (B E) 628 Biochemical Engineering 3(3,0) See B E 628.

CH E 645 Selected Topics in Chemical Engineering 3(3,0) Topics not covered in other courses, emphasizing current literature, research, and practice of chemical engineering. Topics vary from year to year. May be repeated, but only if different topics are covered. *Preq:* Consent of instructor.

CH E 650 Chemical Reaction Engineering 3(3,0) Review of kinetics of chemical reactions and an introduction to the analysis and design of chemical reactors. Topics include homogeneous and heterogeneous reactions, batch and continuous flow reaction systems, catalysis, and design of industrial reactors. *Preq:* CH E 312, 321, CH 332.

CH E 803 Advanced Transport Phenomena 3(3,0) Analysis of heat, mass, and momentum transfer; derivation and application of the governing equations; solution of steady and unsteady-state multidimensional problems in fluid flow, heat transfer, and mass transfer.

CH E 804 Chemical Engineering Thermodynamics 3(3,0) Study of equilibria of physical and chemical systems and generalized properties of hydrocarbons. Includes application of thermodynamic methods in equipment design.

CH E 805 Chemical Engineering Kinetics 3(3,0) Kinetics of chemical reactions, particularly in design and operation of chemical reactors.

CH E (EE&S) 814 Applied Numerical Methods in Process Simulation 3(3,0) Numerical solution techniques as applied to chemical process systems; finite difference techniques for partial differential equations stressing applied numerical methods rather than theoretical numerical analysis. Standard methods for ordinary differential equations are reviewed. *Preq:* Consent of instructor.

CH E 818 Polymer Processing 3(3,0) Processing of polymeric materials; polymer flow characterization; extrusion; mixing; filtration; injection molding; fiber and film formation; physical science principles such as fluid flow, heat transfer, crystallization, and rheology applied to polymer processing operations.

CH E 819 Viscoelastic Properties of Polymers and Polymeric Composites 3(3,0) Time- and frequency-dependent behavior of structural polymers and their composites; interrelationship between various viscoelastic properties; influence of aging; prediction of composite viscoelastic response by application of the Viscoelastic Correspondence Principle. *Preq:* Consent of instructor.

CH E 823 Mass Transfer and Stagewise Contact Operations 3(3,0) Stagewise contact operations emphasizing distillation; vapor-liquid equilibria; integral and differential distillation; binary and multicomponent rectification; analytical methods; batch rectification; azeotropic and extractive distillation.

CH E 834 Advanced Chemical Engineering Thermodynamics 3(3,0) Classical and statistical thermodynamics applied to problems in chemical engineering emphasizing modern methods of predicting thermophysical properties of gases and liquids. Students' and instructor's interests influence course content but usually include fundamentals of applied statistical mechanics, molecular theory of dense fluids, descriptions of intermolecular forces, gas-liquid and liquid-liquid critical phenomena, theories of interfacial phenomena and adsorption, statistical mechanics of polymeric systems, statistical mechanics of polydispersed systems, computer simulation of fluids by Monte Carlo, molecular dynamics, and stochastic dynamics methods. *Preq:* CH E 804 or equivalent.

CH E 845 Selected Topics in Chemical Engineering 3(3,0) Topics not covered in other courses emphasizing current literature and results of current research. Topics vary from year to year to keep pace with developments. May be repeated for credit.

CH E 890 Special Projects 1-6 Comprehensive analytical and/or experimental treatment of phenomena of current interest in chemical engineering emphasizing modern technological problems. May be repeated for maximum of six credits. To be taken Pass/Fail only. *Preq:* Consent of instructor and department chair.

CH E 891 Master's Thesis Research 1-12

CH E 895 Chemical Engineering Graduate Seminar 1(1,0) Series of weekly, one-hour seminars given by students, faculty, and guests on topics of current interest. Credits earned in this course do not apply to or alter the required minimum of six research hours for the MS degree or the required 30 research credit hours for the PhD degree. To be taken Pass/Fail only.

CH E 945 Selected Topics in Chemical Engineering 3(3,0) More comprehensive study of topics first covered in CH E 845.

CH E 991 Doctoral Dissertation Research 1-12

CHEMISTRY

CH 602 Inorganic Chemistry 3(3,0) Basic principles of inorganic chemistry are discussed with special emphasis on atomic structure, chemical bonding, solid state, coordination chemistry, organometallic chemistry, and acid-base theories. The chemistry of certain selected elements is treated. Offered fall semester only. *Preq:* CH 331, 332.

CH 604 Bioinorganic Chemistry 3(3,0) Covers fundamentals of bioinorganic chemistry with review of necessary inorganic and biochemical concepts. Topics include metal uptake, transport, and storage in biological systems; functions of metals in proteins; metal ion interactions with nucleic acids; physical methods used in bioinorganic chemistry; heavy element toxicity, radiopharmaceuticals and other metallodrugs. *Preq:* BIOCH 301 or CH 205.

CH 611 Instrumental Analysis 3(3,0) Principles of operation and application of modern chemical instrumentation in the field of analytical chemistry. Topics include basic electronics, statistics, optical, mass, magnetic resonance, electron and x-ray spectroscopies, radiochemistry, and separation science. *Preq:* CH 331, 332.

CH 614 Bioanalytical Chemistry 3(3,0) Survey of selected areas of importance in bioanalytical chemistry. Includes fundamental principles, advanced topics, and applications of analytical measurements of biomolecules, bioassays, immunoassays, separations, mass spectrometry, method validation, macromolecular crystallography, microscopy, and imaging. *Preq:* CH 313, 411, or consent of instructor.

CH 621 Advanced Organic Chemistry 3(3,0) Survey of modern organic chemistry with an emphasis on synthesis and mechanisms. *Preq:* CH 224, 332 or equivalent.

CH 625 Medicinal Chemistry 3(3,0) Survey of the pharmaceutical drug discovery process. Covers discovery of candidate compounds; bioassay methods; associated regulatory and commercial issues. Case studies are selected from the current literature. *Preq:* CH 224 or equivalent or consent of instructor.

CH 627 Organic Spectroscopy 3(2,3) Survey of modern spectroscopic techniques used in the determination of molecular structure. Emphasis is on the interpretation of spectra: nuclear magnetic resonance, ultraviolet, infrared, mass spectrometry, optical rotatory dispersion and circular dichroism. *Preq:* One year each of organic chemistry and physical chemistry.

CH 635 Atomic and Molecular Structure 3(3,0) Introduction to quantum theory and its application to atomic and molecular systems. Topics include harmonic oscillator, hydrogen atom, atomic and molecular orbital methods, vector model of the atom, atomic spectroscopy, and molecular spectroscopy. Offered spring semester only. *Preq:* CH 332 or consent of instructor.

CH 651 Frontiers in Polymer Chemistry 3(3,0) Survey of selected areas of current research in polymer science with particular emphasis on polymer synthesis. Although a text is required for review and reference, course is primarily literature based and focused on areas of high impact to multidisciplinary technology. *Preq:* CH 223, 224, PFC 415 or consent of instructor.

CH 671 Teaching Chemistry 3(3,0) Topics in chemistry addressed in the context of constructivist methodologies. Also considers laboratory work and management, laboratory safety, and the use of technology in the chemistry classroom. *Preq:* 300-level chemistry course or high school teaching experience or consent of instructor.

CH 704 Selected Topics for Chemistry Teachers 1-6(1-6,1-6) Directed individual study in designing experiments and teaching materials or an in-depth study of one or more advanced topics. For graduate students in Elementary and Secondary Education. May be repeated, but only if different topics are covered. Offered spring semester of odd-numbered years only.

CH 800 Professional Development Issues in Chemistry 1(1,0) Covers development of professional behavior for graduate students in chemistry, including communication skills, teaching techniques, research ethics, career management, "grantsmanship," and intellectual property issues in science. *Preq:* Graduate standing in Chemistry.

CH 805 Theoretical Inorganic Chemistry 3(3,0) Application of group theory to structure and properties of inorganic molecules. Offered spring semester of odd-numbered years only. *Preq:* CH 435 and 804 or consent of instructor.

CH 807 Chemistry of the Transition Elements 3(3,0) Structure, spectroscopy, and reactivity of transition metals and their compounds. Offered fall semester only. *Preq:* CH 804 or consent of instructor.

CH 808 Chemistry of the Nonmetallic Elements 3(3,0) Development and application of a bonding model for descriptive inorganic chemistry of boron, carbon, silicon, nitrogen, phosphorus, oxygen, and sulfur. Offered spring semester of odd-numbered years only. *Preq:* CH 804 or consent of instructor.

CH 809 Chemical Applications of X-Ray Crystallography 3(2,2) Physical description of the crystalline state, symmetry in crystals, X-ray diffraction, modern methods of structure determination, and chemical interpretation of structural results. Offered spring semester of odd-numbered years only. *Preq:* CH 331 and 332 or consent of instructor.

CH 811 Analytical Chemistry 3(3,0) Graduate-level review of modern analytical chemistry; literature, sampling, quality control/assurance, chemometrics, and the use of modern analytical methods; team taught by the analytical faculty. Offered fall semester only.

CH 812 Chemical Spectroscopic Methods 3(2,3) Emission and absorption spectroscopy, chemical microscopy, X-ray diffraction, and fluorescence techniques in analytical chemistry; theory and operation of instruments.

- CH 813 Electrochemical Science 3(3,0)** Theory and experimental study of electrochemical thermodynamics, electrified interfaces, interfacial charge transfer, electrolyte solutions, electrode processes, and membrane electrochemistry; amperometric, voltammetric, electrolytic, and potentiometric methods; practical applications of electrochemistry in analysis, materials synthesis and energy technology. *Preq:* Graduate standing in Chemistry or Chemical Engineering or consent of instructor.
- CH 816 Separation Science 3(3,0)** Fundamental thermodynamic and kinetic concepts of separation and practical aspects of current separation techniques used in analytical chemistry. Offered spring semester of odd-numbered years only.
- CH 818 Surface and Thin Film Analysis 3(2,2)** Fundamental principles underlying the most commonly employed techniques for surface and thin films analysis. Representative techniques include atomic force microscopy, scanning electron microscopy, secondary ion mass spectrometry, Auger electron spectroscopy, and Rutherford backscattering. Laboratory exercises give insights into analytical methods.
- CH 821 Organic Chemistry I 3(3,0)** Theoretical concepts of organic chemistry, stereochemistry, and mechanisms of organic reactions. Offered fall semester only. *Preq:* CH 421 or satisfactory performance on the organic chemistry placement examination.
- CH 822 Organic Chemistry II 3(3,0)** Continuation of CH 821; mechanisms of organic reactions including photochemistry and Woodward-Hoffman rules; modern synthetic organic chemistry. Offered spring semester only. *Preq:* CH 821 or consent of instructor.
- CH 830 Fundamentals of Physical Chemistry 3(3,0)** Principles of classical thermodynamics, chemical kinetics, and quantum chemistry. Offered fall semester only. *Preq:* CH 331 or equivalent.
- CH 831 Chemical Thermodynamics 3(3,0)** Classical thermodynamics emphasizing theory and significance of energetics and systems of variable composition. Offered fall semester of odd-numbered years only. *Preq:* CH 331 or equivalent.
- CH 834 Statistical Thermodynamics 3(3,0)** Study of statistical thermodynamics including ensemble method, ideal gases, internal degrees of freedom, solid state, imperfect gases, distribution function method in fluids, and time-dependent fluctuations. *Preq:* CH 831.
- CH 835 Chemical Kinetics 3(3,0)** Rate processes and reaction mechanisms; order of reaction; theory of rate processes; relation of reaction rates to mechanism; homogeneous and heterogeneous catalysis; experimental methods; chain reactions; diffusion; effects of solvent, temperature, and pressure on reaction rates and mechanisms. Lectures are supplemented by assigned problems, paper, and oral examination of topic of special interest to the student. Offered spring semester of odd-numbered years only.
- CH 837 Quantum Chemistry 3(3,0)** Mathematical and conceptual formulation of quantum theory of electronic structure of atoms and molecules; eigenvalue solution of one-dimensional Schrödinger equation and application of this method to chemical problems. Offered fall semester of odd-numbered years only.
- CH 838 Computational Chemistry 3(3,0)** Theoretical methods and software used in computational chemistry; quantum chemical methods including molecular orbital methods and density functional theory; classical simulation techniques including potential energy functions, molecular mechanics, molecular dynamics, and Monte Carlo. Advanced topics vary with interests of students. *Preq:* CH 331 and 332 or equivalent.
- CH 840 Techniques of Experimental Chemistry 3(1,6)** Theory and practice in major experimental techniques used in chemical research; chromatography; NMR, IR, visible, UV, and ORD/CD spectrophotometry; glassblowing and high vacuum techniques; mass spectrometry; ESR; Mössbauer spectrometry and tracer analysis.
- CH 841 Chemical Applications of NMR Spectroscopy 3(2,2)** Basic concepts of NMR spectroscopy with application to organic, inorganic, physical, and analytical chemistry; design of spectroscopic experiments and interpretation of spectra; modern techniques including multipulse, multinuclear, and two-dimensional methods. Offered fall semester only. *Preq:* CH 331 and 332 or consent of instructor.
- CH 851 Graduate Student Seminar 1-2(1-2,0)** Students and faculty review current topics in chemistry. May be taken more than one semester.
- CH 852 Departmental Seminar 1-2(1-2,0)** Off-campus speakers are invited to present aspects of their research to the chemistry faculty and graduate students every week during the academic year. Some of these talks may form the basis for cumulative examination questions. Attendance is mandatory. May be taken more than one semester. *Preq:* Approved bachelor's degree.
- CH 860 Chemical Biology 3(3,0)** Covers fundamentals of chemical biology by examining the structure, function, bonding, and reactivity of nucleic acids, proteins, carbohydrates, and lipids. Topics are covered from the perspective of organic, inorganic, analytic, and physical chemistry. Credit will be given for only one of CH 860, BIOC 631. *Preq:* Undergraduate coursework in organic, inorganic, physical, and analytic chemistry; or consent of instructor.
- CH 891 Master's Thesis Research 1-12**
- CH 900 Selected Topics in Inorganic Chemistry 1-4(1-4,0)** Metal-metal bonding; homogeneous catalysis; photochemistry; bioinorganic chemistry; solid state chemistry. Topics vary with interests of students. May be repeated for credit if different topics are covered.
- CH 910 Selected Topics in Analytical Chemistry 1-4(1-4,0)** New techniques and their applications in analytical chemistry; laser methods; data acquisition processing; electronics, instrument/computer interfacing; field methods of sampling and analysis. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.
- CH 920 Selected Topics in Organic Chemistry 1-4(1-4,0)** Heterocyclic compounds; stereochemistry; natural products; organometallic chemistry; photochemistry. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.
- CH 930 Selected Topics in Physical Chemistry 1-4(1-4,0)** Special problems in molecular spectroscopy, molecular orbital treatments, applications of group theory to chemical structure, irreversible thermodynamics, and special topics in statistical mechanics. Topics vary with interests of students. May be repeated for credit, but only if different topics are covered.
- CH 991 Doctoral Dissertation Research 1-12**

CITY AND REGIONAL PLANNING

- C R P 601 Introduction to City and Regional Planning 3(3,0)** Introduces students from other disciplines to City and Regional Planning. Spatial and nonspatial areas of discipline are explored through a wide ranging lecture/seminar program. *Preq:* Consent of instructor.
- C R P 602 Human Settlement 3(3,0)** Overview of forces and trends affecting community growth and change—historical, ecological, economic, demographic, design, and development—pertaining to human settlement patterns and their interrelationship in the urbanization process, especially at the national, regional, townscape, and neighborhood scale. Team-taught from various perspectives. Intended as a foundation core course for Master's in Real Estate Development, City and Regional Planning, and Landscape Architecture. *Preq:* Consent of instructor.
- C R P 603 Seminar on Planning Communication 3(3,0)** In-depth analysis of methods to communicate planning and policy decisions effectively. Familiarizes students with the various communication skills needed by planners, policy makers, and other professionals to become successful practitioners. *Preq:* Consent of instructor.
- C R P (C E) 612 Urban Transportation Planning 3(3,0)** See C E 612.
- C R P 634 Geographic Information Systems for Landscape Planning 3(1,6)** Develops competence in geographic information systems technology and its application to various spatial analysis problems in landscape planning. Introduces basic principles of GIS and their use in spatial analysis and information management. Topics include database development and management, spatial analysis techniques, cartography, critical review of GIS applications, and hands-on projects.
- C R P 801 Planning Process and Legal Foundations 3(3,0)** Introduction to the city and regional planning profession and related processes with the legal foundation for comprehensive planning and tools of implementation. *Preq:* Consent of instructor.
- C R P 802 Site Planning and Infrastructure 3(2,3)** Working knowledge of natural systems and infrastructure systems as they affect site planning and development. *Preq:* Consent of instructor.

- C R P 803 Quantitative Analysis 4(2,6)** Basic tools of quantitative analysis and planning methods in the context of analytical, procedural, and institutional needs of the planner. Students learn data collection, analysis, and interpretation of different planning problems. Emphasis is placed on understanding the logic of statistical analysis, methods of planning analysis, and policy formation. *Preq:* Consent of instructor.
- C R P 804 Land Use Analysis and Assessment 4(2,6)** Introduction to basic methods of land use planning including land suitability analysis, land market forecasts, and formulating alternative land use plans. Development impact assessment and project appraisal methods are introduced to evaluate land use plans. *Preq:* C R P 803.
- C R P 805 Planning Theory and History 3(3,0)** Development of the planning practice and theories of planning process: historical evolution of planning practice in the U.S., social issues in planning, theories of planning and critiques of those theories, and ethical issues in planning practice. *Preq:* Consent of instructor.
- C R P 806 Urban Systems and Growth Management 3(3,0)** Overview of basic principles of resource allocation including public finance and project appraisal techniques. Introduces infrastructure planning and capital improvement plans followed by basic concepts of growth management and an overview of growth management laws and tools. Course is team-taught to address diverse subject matter. *Preq:* Consent of instructor.
- C R P 807 Professional Studio 4-6(2-3,6-9)** Serves as a vehicle for synthesis and application of skills developed in other courses and includes participation in one or more real-world planning projects in addition to seminars and readings devoted to development of professional practice skills. *Preq:* Consent of instructor.
- C R P 822 Urban Design 3(3,0)** Analysis of the evolution of the physical patterns of cities through research in the historical development of urban form in Europe and America within the context of prevailing social, economic, and political influences; approaches to the analysis of contemporary cities through the study of modern planning theorists. *Preq:* Consent of instructor.
- C R P 830 Introduction to GIS 1(1,0)** Introduces participants to ArcGIS as a tool for real estate development analysis and provides the foundation for becoming a successful GIS user. Students are introduced to fundamental GIS concepts. Topics include displaying, downloading, analyzing, and printing public domain geographical data sets. *Preq:* Consent of instructor.
- C R P 832 Problems in Site Planning 3(1,6)** Advanced site planning and design concept studies developed through site projects; concentration on industrial, residential, and recreational facilities. Emphasis is on use-specific site analysis and generation of development alternatives. *Preq:* Consent of instructor.
- C R P 834 Spatial Modeling Using GIS 3(2,3)** Use of geographic information systems (GIS) in spatial analysis, information management, and synthesis of spatial patterns and processes. Emphasizes developing an operational understanding of the modeling techniques and data used in different applications such as land use allocation, corridor location, site location and market analysis, environmental assessment, and cost-benefit analysis. *Preq:* C R P 634 or 804; or consent of instructor.
- C R P 835 GIS and Remote Sensing Applications for Trend Analysis 3(2,3)** Principles of remote sensing and land information systems in trend analysis. Addresses aspects of change detection for monitoring natural resources and urban growth. Designed for those interested in planning, natural resources management, and environmental analysis. Lectures and hands-on laboratory work emphasize the use of imagery for database generation and analysis. *Preq:* C R P 634, 804, or 834; or consent of instructor.
- C R P 840 Seminar in Coastal Planning 3(3,0)** Issues relating to development and conservation of coastal environments, focusing on inherent tradeoffs between growth and environmental quality. Discusses ecology and carrying capacity of coastal areas and appropriate management approaches to balance coastal resource demand. *Preq:* Consent of instructor.
- C R P 841 Seminar in Environmental Planning 3(3,0)** Current and emerging environmental issues and appropriate planning options, including population dynamics and limits to growth, entropy law, waste management, and global climate change; students pursue individual research on an environmental issue of particular concern and report findings. *Preq:* Consent of instructor.
- C R P (PRIM) 844 Outdoor Recreation Resource Management and Planning 3(3,0)** Issues relating to planning and development of natural areas for recreational purposes. Emphasis is on the policy-making process at the federal, state, regional, and local levels. *Preq:* Consent of instructor.
- C R P 858 Research Design 3(3,0)** Provides opportunity for students in their final year of study in the planning program to develop a proposal for the terminal project or thesis. Students are responsible for completing the research, writing, and editing necessary for an acceptable proposal. *Preq:* Consent of faculty.
- C R P 859 Planning Terminal Project 3(0,9)** Students select, with approval of advisor, and conduct research on individual planning problems of suitable scope. Oral, written, and, where appropriate, visual presentations of solution are required. Students must enroll during final semester. *Preq:* C R P 858.
- C R P (PO ST) 870 Seminar in Sustainable Development 3(3,0)** See PO ST 870.
- C R P 871 Growth Management and Legal Issues 3(3,0)** Basic laws and court cases relating to the comprehensive plan, implementing tools, and other aspects of the planning process in the growth management context. *Preq:* C R P 672, consent of instructor or department chair.
- C R P 872 Housing Issues in the United States 3(3,0)** Regulation, stimulation, salvage, and replacement of housing through public policy administrative procedures. Specific housing programs are analyzed in detail. *Preq:* Consent of instructor.
- C R P 873 Economic Development Planning 3(3,0)** Economic development planning process, focusing on applied programmatic techniques, especially at the state, local, and neighborhood levels. Emphasizes theoretical models, economic development process, private/public partnerships, economic development tools, political context, and economic development planning administration and organization. *Preq:* Consent of instructor.
- C R P 883 Techniques for Analyzing Development Impacts 3(3,0)** Models and techniques for analyzing development impacts in urban areas and regions; economic, fiscal, social, and environmental impact methods. Operational knowledge of these techniques is developed. *Preq:* Consent of instructor.
- C R P 889 Selected Topics in Planning 3(3,0)** Topics emphasizing current literature and results of current research. May be repeated for credit. *Preq:* Consent of instructor.
- C R P 890 Directed Studies in City and Regional Planning 1-6(0,3-18)** Students pursue individual professional interests under guidance of City and Regional Planning graduate faculty. May be repeated for credit.
- C R P 891 Planning Thesis 6(0,18)** Students, working individually, program a planning problem of appropriate scope and conduct research. Oral, written and, where appropriate, visual presentations of theses are required. To be taken Pass/Fail only. *Preq:* Consent of faculty.
- C R P 893 City and Regional Planning Internship 3(0,9)** Ten weeks of supervised professional employment with an approved planning entity. To be taken Pass/Fail only. *Preq:* Two semesters of City and Regional Planning or equivalent.
- C R P 894 Planning Internship Seminar 3(3,0)** Seminar-based analysis of student internships, enabling students to compare experiences and gain greater understanding of professional practice by reflecting on planning issues. To be taken Pass/Fail only. *Preq:* C R P 893.

CIVIL ENGINEERING

- C E 601 Indeterminate and Matrix Structural Analysis 3(3,0)** Analysis of indeterminate structures using moment distribution, energy methods such as virtual work and Castigliano's Theorem, and the matrix formulation of the direct stiffness method. *Preq:* C E 301 or consent of instructor.
- C E 604 Masonry Structural Design 3(3,0)** Introduction to design of structural elements for masonry buildings. Lintels, walls, shear walls, columns, pilasters, and retaining walls are included. Reinforced and unreinforced elements of concrete or clay masonry are designed by allowable stress and strength design methods. Introduction to construction techniques, materials, and terminology used in masonry. *Preq:* C E 402 or consent of instructor.

- C E 607 Wood Design 3(3,0)** Introduction to wood design and engineering; properties of wood and wood-based materials; design of beams, columns, walls, roofs, panel systems, and connections. *Preq:* C E 402 or 406, or consent of instructor.
- C E 608 Structural Loads and Systems 3(3,0)** In-depth discussion of minimum design loads and load combinations. Includes overview of various steel and concrete systems. Discusses practical selection and design issues and design of proprietary building materials and components such as steel joists, diaphragms, engineered wood products, etc. *Preq:* C E 206, 301.
- C E 610 Traffic Engineering Operations 3(3,0)** Basic characteristics of motor-vehicle traffic, highway capacity, applications of traffic control devices, traffic design of parking facilities, engineering studies, traffic safety, traffic laws and ordinances, public relations. *Preq:* C E 311 or consent of instructor.
- C E 611 Roadway Geometric Design 3(2,3)** Geometric design of roadways, at-grade intersections, and interchanges in accordance with conditions imposed by driver ability, vehicle performance, safety, and economics. *Preq:* C E 311 or consent of instructor.
- C E (C R P) 612 Urban Transportation Planning 3(3,0)** Urban travel characteristics, characteristics of transportation systems, transportation and land-use studies, trip distribution and trip assignment models, city patterns, and subdivision layout. *Preq:* C E 311 or consent of instructor.
- C E 621 Geotechnical Engineering Design 3(3,0)** Relationship of local geology to soil formations, groundwater, planning of site investigation, sampling procedures, determination of design parameters, foundation design, and settlement analysis. *Preq:* C E 321 or consent of instructor.
- C E 624 Earth Slopes and Retaining Structures 3(3,0)** Principles of geology, groundwater and seepage, soil strength, slope stability, and lateral earth pressure and their application to the design of excavations, earth fills, dams, and earth-retaining structures. *Preq:* C E 321 or GEOL 320 or consent of instructor.
- C E 633 Construction Planning and Scheduling 3(3,0)** Principles and applications of the Critical Path Method (CPM) and Project Evaluation and Review Techniques (PERT). Project breakdown and network graphics. Identification of the critical path and resulting floats. Definition and allocation of materials, equipment, and manpower resources. Resource leveling, compression, and other network adjustments. Computer applications using packaged routines. *Preq:* C E 331 or consent of instructor.
- C E 634 Construction Estimating and Project Control 3(3,0)** Study of specifications, contracts, and bidding strategies; purchasing and subcontracting policies; accounting for materials, supplies, subcontracts, and labor; procedural details for estimating earthwork, reinforced concrete, steel, and masonry; overhead and profit items. *Preq:* C E 331 or consent of instructor.
- C E 638 Construction Support Operations 3(3,0)** Describes activities necessary for the completion of a construction job although not specifically recognized as direct construction activities: general conditions, safety, security, quality assurance, value engineering; organizational support features, and typical implementation procedures. *Preq:* C E 331 and EX ST 301, or consent of instructor.
- C E 643 Water Resources Engineering 3(3,0)** Extension of the concepts of fluid mechanics to applications in water supply, water resource assessment, water transmission, water distribution networks, pump and pipe selection, pipe networks, and analysis of open channel appurtenances. *Preq:* C E 341.
- C E 646 Flood Hazards and Protective Design 3(3,0)** Study of flood hazards and methods of protective design of the built environment. Floodplain mapping and delineation. Methods for determining base flood elevations. Flood-resistant construction, flood proofing, and governmental regulations are discussed. Includes case studies and design projects. *Coreq:* C E 342 or consent of instructor.
- C E 647 Stormwater Management 3(3,0)** Evaluation of peak discharges for urban and rural basins, design of highway drainage structures such as inlets and culverts; stormwater and receiving water quality; best management practices; detention and retention ponds; and erosion and sediment control. *Preq:* C E 342. *Coreq:* EE&S 401 or consent of instructor.
- C E 648 Physical Models in Hydraulics 3(2,3)** Tools and techniques of physical modeling to aid in design of complex hydraulic systems. Students participate in construction, operation, and testing of physical models to solve hydraulic engineering design problems. Experimental design and operation are covered. *Preq:* C E 342 or consent of instructor.
- C E 649 Hydraulic Structures 3(3,0)** Design methods and procedures are taught for a variety of hydraulic structures including intake structures, complex open-channel and closed conduit control structures, transitions, spillways, small dam, and pond design. Field trips to actual hydraulic structures may be included. *Preq:* C E 342 or consent of instructor.
- C E 655 Properties of Concrete and Asphalt 3(2,3)** Properties of aggregate, concrete, and asphalt; concrete and asphalt mix designs are conducted in the laboratory. *Preq:* C E 351 and EX ST 301, or consent of instructor.
- C E 662 Coastal Engineering I 3(3,0)** Introduction to coastal and oceanographic engineering principles including wave mechanics, wave-structure interaction, coastal water-level fluctuations, coastal-zone processes, and design considerations for coastal structures and beach nourishment projects. *Preq:* C E 341 or consent of instructor.
- C E 682 Groundwater and Contaminant Transport 3(3,0)** Basic principles of groundwater hydrology and transport of contaminants in groundwater systems; groundwater system characteristics; steady and transient flow; well hydraulics, design and testing; contaminant sources, movement and transformations. *Preq:* C E 341. *Coreq:* EE&S 401.
- C E 691 Selected Topics in Civil Engineering 1-6(1-6,0)** Structured study of civil engineering topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.
- C E 801 Matrix and Finite Element Analysis 3(3,0)** Matrix and finite element methods in solution of engineering problems; stiffness matrices for triangular, rectangular, and quadrilateral elements in planer systems; plate bending, shell, and 3-D elements; applications to solutions of structural and soil mechanics problems using special and general purpose programs. *Preq:* C E 401 or consent of instructor.
- C E 802 Advanced Reinforced Concrete Design 3(3,0)** Second course in design of reinforced concrete structures; advanced concepts in analysis and design of beams, columns, and slabs; introduction to prestressed concrete. *Preq:* C E 402 or consent of instructor.
- C E 803 Advanced Steel Design 3(3,0)** Advanced design of structural steel buildings emphasizing the relationship between design and response of the structural system. Includes theoretical basis of building code provisions, limit state and plastic design, beam-columns, plate girders, and composite sections and connections. *Preq:* C E 406 or consent of instructor.
- C E 804 Prestressed Concrete 3(3,0)** Introduction to the analysis, behavior, and design of prestressed concrete members and structures. Covers allowable stress design and strength design of P/C members, shear design, loss of prestress force, design of continuous structures. *Preq:* C E 401 and 402, or consent of instructor.
- C E 805 Advanced Structural Mechanics 3(3,0)** Development and utilization of mechanics principles in solution of structural problems; unsymmetrical bending and curved beams; beams on elastic foundations; plastic structure analysis of beams and frames; eigenvalue problems; plastic stress-strain relations; strain energy; series and finite element solutions to plate and shell structures. *Preq:* C E 401 or consent of instructor.
- C E 806 Dynamic Analysis of Structures 3(3,0)** Analysis and design of structures subjected to dynamic loading; response of lumped and distributed parameter systems of one or many degrees of freedom; approximate design methods; introduction to earthquake analysis and design. *Preq:* C E 801 or consent of instructor.
- C E 807 Wind Engineering 3(2,2)** Effects of wind on buildings, bridges, and other structures; meteorological aspects of wind generation; types and characteristics of various wind events; aerodynamics of flow around structures; wind-induced loads; structural responses; design basis safety and serviceability criteria.
- C E 808 Earthquake Engineering 3(3,0)** Effects of earthquake-induced forces on buildings, bridges, and other structures; development of design codes and their application to the design of structures to resist seismic forces; fundamental structural dynamics and analysis techniques used to compute the response of structures or obtain design forces. *Preq:* C E 806 or consent of instructor.

- C E 809 Forensic Engineering 3(3,0)** Study of civil engineering failures including analyses of conditions just prior to the failure, load or event causing failure. Also covers methods of investigation and design of remedial measures, case histories of failures illustrating common errors and failures. Student projects involve design of remedial measures and alternatives.
- C E 813 Highway and Airport Pavement Design 3(3,0)** Structural design of rigid and flexible pavements; design of bases and subbases; theory of stresses and application of plate bearing, triaxial and California Bearing Ratio design methods to flexible pavements; Westergaard analysis for rigid pavements; pavement evaluation methods. *Preq:* C E 311 and 321, or consent of instructor.
- C E 815 Transportation Safety Engineering 3(3,0)** Methodology for conducting transportation accident studies; accident characteristics as related to operator, facility, and mode; statistical applications to accident data; current trends and problems in transportation safety. *Preq:* C E 311 or consent of instructor.
- C E 820 Geotechnical Site Characterization 3(3,0)** Study of advanced methods of subsurface investigation for design of civil structures in soil and rock. Includes field reconnaissance, interpretation of geologic maps and cross sections, drilling, in situ testing, sampling, characterization of soil and rock formations, and selection of engineering properties. *Preq:* C E 321 or equivalent.
- C E 821 Advanced Soil Mechanics 3(3,0)** Study of stresses in soils, plastic equilibrium of soil masses, failure conditions, earth pressures, analysis of flexible retaining wall bulkheads, and solution of problem by elastic theory. *Preq:* C E 321 or consent of instructor.
- C E 822 Foundation Engineering 3(3,0)** Requirements for satisfactory foundations; theory and design of shallow foundations; pressure distribution beneath rigid and flexible shallow foundations; bearing capacity and settlement of deep foundations; foundation failures. *Preq:* C E 821 or consent of instructor.
- C E 823 Asphalt Concrete Properties 3(3,0)** Includes identification and suitability of aggregates for construction. Covers characteristics and properties of bituminous materials and materials behavior, construction, and design problems. Requires use of microcomputers and the mainframe. *Preq:* C E 351 or consent of instructor.
- C E 825 Soil Dynamics and Geotechnical Earthquake Engineering 3(3,0)** Fundamentals of soil dynamics, plate tectonics, and earthquakes; application of the concepts to seismic ground response, design ground motions, soil liquefaction, seismic slope stability, dynamic lateral earth pressures, and soil improvement. *Preq:* C E 421, 424, or consent of instructor.
- C E 826 Properties of Portland Cement Concrete 3(3,0)** Material science and engineering of Portland cement concrete. Topics include physical and chemical properties of cements; mixture proportioning; mixing; placement; curing techniques; specifications, tests, and evaluation of fresh and hardened concrete; durability issues; and considerations in specialized applications. *Preq:* C E 351 or consent of instructor.
- C E 827 Special Cements and Concrete 3(3,0)** Study of material science and engineering aspects of specialty concretes that are used in unique civil engineering applications, including high-strength concrete, high performance concrete, highly flowable concrete, underwater concrete, shotcrete, and others. Exposes students to properties and applications of specialty cements and admixtures that are often used in these special applications. *Preq:* C E 826 or equivalent.
- C E 828 Repair and Rehabilitation of Concrete Structures 3(3,0)** Provides students with a knowledge of different types of failures in concrete associated with material durability, construction, and design (load) related failures. Also provides knowledge to identify, assess, and remediate damage in concrete pavements and structures. Introduces the concepts and tools related to structural health monitoring. *Preq:* C E 826.
- C E 829 Geosynthetics 3(3,0)** Study of geosynthetics including geotextiles, geogrids, geomembranes, geonets, geosynthetic clay liners, geopipe, and geocomposites which are used in many aspects of civil engineering for soil structures, retaining walls, pavement construction and rehabilitation, drainage, filtration, and containment facilities. Covers production of geosynthetics, material properties, design aspects, and field installation. *Preq:* C E 321 and 351 or their equivalents.
- C E 835 Construction Project Modeling 3(3,0)** Mathematical and computer models are used to simulate construction operations. Covers linear models and optimization applications to construction materials, scheduling, and equipment allocation; typical computer models used in construction using simple modeling examples. *Preq:* C E 331 or consent of instructor.
- C E 836 Civil Engineering Quality Management 3(3,0)** Principles of total quality management (TQM) and their applications in the engineering and construction industry; TQM implementation techniques emphasizing the construction environment; concepts of quality assurance (QA) and quality control (QC) in construction.
- C E 837 Construction Specifications and Contracts 3(3,0)** Elements of specifications delineating responsibilities of all involved parties and identifying courses of action during abnormal circumstances; necessary parts of a contract dealing with governmental regulations and institutional preferences, licenses, bonds, insurance, and taxes. *Preq:* C E 331 or consent of instructor.
- C E 838 Materials Management 3(3,0)** Functions of construction materials management including design interface, purchasing, expediting, transportation, field control, and warehousing; design and application of integrated materials management computer systems; new technology that impacts materials management including bar coding, electronic data interchange, and voice recognition. *Preq:* Consent of instructor.
- C E 840 Project Management Applications 3(3,0)** Quantitative tools for effective management and control of engineered projects from design through construction; cost coding and control, advanced schedule management techniques and quality management principles; extensive hands-on use of the microcomputer. *Preq:* C E 433 and 434, or consent of instructor.
- C E 846 Flow in Open Channels 3(3,0)** Free surface flow problems; applications of digital computer; concepts of boundary layer theory; uniform and varied flow; hydraulic jump; design criteria for prismatic channels and transitions; applications of unsteady flow. *Preq:* C E 342 or consent of instructor.
- C E 851 Reliability 3(3,0)** Elements of probabilistic methods; classical theory of structural reliability and reliability-based design methods. Term project required on reliability design in a relevant field of civil engineering.
- C E 853 Applications in Traffic Engineering 3(2,3)** Highway capacity analysis; design of unsignalized intersections; intelligent transportation systems; parking; traffic signal coordination; microscopic and macroscopic traffic simulation. *Preq:* C E 410 or consent of instructor.
- C E 854 Travel Demand Forecasting 3(2,3)** In-depth coverage of travel-demand forecasting theory and the four-step process; site impact analysis; disaggregate demand models. Students work in groups to develop a computer-based travel forecasting model for a small city. *Preq:* C E 412 or consent of instructor.
- C E 855 Transportation Seminar 1(1,0)** Practical discussion of the transportation profession featuring faculty and off-campus experts. Course is highlighted by a retreat where students present their transportation research.
- C E 860 Advanced Fluid Mechanics 3(3,0)** Laminar and turbulent flows; boundary layer and free shear flows (jets, wakes, etc.); descriptions of velocity, shear stress and pressure measurements, and aerodynamic drag.
- C E 861 Mechanics of Sediment Transport 3(3,0)** Characterization of sediments; physical principles governing fluvial, estuarial, and coastal transport of cohesionless and cohesive sediments, including incipient motion, stable channel design, bedforms, and bedload and suspended transport. *Preq:* C E 342 or consent of instructor.
- C E 865 Hydrologic Systems Analysis 3(3,0)** Hydrologic cycle as a hydrologic system; deterministic hydrology; aspects of physical hydrology emphasizing balanced approach to groundwater hydrology and surface water hydrology; infiltration; soil moisture and evapotranspiration; probability analysis and system synthesis by convolution. *Preq:* C E 342 or consent of instructor.
- C E 867 Pipeline Hydraulics 3(3,0)** Pressurized pipeline design including economic analysis, pipe sizing and selection; applications in civil engineering; prediction and control of cavitation; transient analysis; and methods of suppression. Students participate in a team-oriented design project. *Preq:* C E 341 or consent of instructor.
- C E 868 Environmental Fluid Mechanics and Hydraulics 3(3,0)** Study of turbulence and basic flow equations as they impact the environment. Includes slender flows including circular and plane turbulent jets, jets in crossflows, wall, surface jets, and plumes; near-field and far-field analysis of discharge in rivers including continuous momentum discharges, nonbuoyant plumes, and passive slugs; mixing in lakes and reservoirs; and stratified flows.

C E 875 Numerical Models in Hydraulics 3(3,0)
Students learn applications of numerical modeling, finite difference, finite volume, and finite element, as tools for solving complex problems in the areas of hydraulics/fluid mechanics. Students learn techniques of developing and analyzing computational models for parabolic, elliptic, and hyperbolic equations used in the area of hydraulics. *Preq:* C E 342 or consent of instructor.

C E 889 Special Problems I 1-3 Research design problems from field of structures, construction, soil mechanics, transportation, ocean and coastal engineering, or materials engineering. Subject matter varies with interest and experience of student and instructor.

C E 890 Special Problems II 1-3 Research design problems from field of structures, construction, soil mechanics, transportation, ocean and coastal engineering, or materials engineering. Subject matter varies with interest and experience of student and instructor.

C E 891 Master's Thesis Research 1-12

C E 893 Selected Topics in Civil Engineering 1-6(1-6,1-6) Topics not covered in other courses. May be repeated for credit.

C E 895 Civil Engineering Seminar 1(0,2) Current and historic topics in various areas of civil engineering. Speakers may include off-campus experts, faculty, and graduate students. Presentation of at least one seminar is required.

C E 991 Doctoral Dissertation Research 1-12

COLLEGE OF ENGINEERING AND SCIENCE

CES 603 Career Success in Research and Development 1(1,0) Assists students in making personal and professional transition into industrial research careers. Offers advice and introduces and demonstrates practical techniques to help students avoid early career land mines. *Preq:* Junior standing in engineering or science discipline.

CES 850 Special Topics in Engineering and Science Education 1-4(1-4,0) Advanced topics intended to develop in-depth areas of particular student interest. May be repeated for a maximum of 15 credits. *Preq:* Consent of instructor.

CES 861 Practicum in Engineering and Science Education 1-3(1-3,0) Practicum that includes teaching or mentoring undergraduates in Engineering and Science (General Engineering or student's home department). Counts towards a Certificate in Engineering and Science Education. May be repeated for a maximum of three credits.

CES 871 Engineering and Science Education Research Methods 3(3,0) Introduces methods and tools available for conducting pedagogically sound engineering and science education research. Quantitative, qualitative, and mixed methods are discussed and practiced.

COMMUNICATION STUDIES

COMM (ENGL) 651 Film Theory and Criticism 3(2,3) See ENGL 651.

COMM 664 Advanced Organizational Communication 3(3,0) Application of speech communication methodology to the analysis of organizational communication processes. Students study methods of organizational communication analysis and intervention. *Preq:* COMM 364 or consent of instructor.

COMM 670 Communication and Health 3(3,0) Considers institutional and health-care communication issues as well as the relationship between social issues, communication, and health. *Preq:* COMM 201 with a C or better or consent of instructor.

COMM (ENGL) 691 Classical Rhetoric 3(3,0) See ENGL 691.

COMM (ENGL) 692 Modern Rhetoric 3(3,0) See ENGL 692.

COMM (ENGL) 804 Fundamentals of Health Communication 3(3,0) See ENGL 804.

COMM (ENGL) 807 Health Communication Campaign Planning and Evaluation 3(3,0) See ENGL 807.

COMM (A A H, ENGL) 840 Selected Topics 3(3,0) See ENGL 840.

COMM 871 Leadership Communication 3(3,0) Develops ability and knowledge of communicative aspects of leadership. Students integrate theories and practices of persuasion, motivation, and media to actualize a leadership vision. Students explore issues and research in ethical and intercultural applications, including implications of institutional structures and their impact on society.

COMM 873 Designing Workplace/Electronic Performance Support 3(3,0) Analysis and design of application components and on-line design processes that solve organizational performance issues and contribute to workplace enhancement.

COMM 874 Special Topics in Communication Studies 3(3,0) Varying topics within the field of communication studies. May be repeated for a maximum of six credits, but only if different topics are covered.

COMMUNITY AND RURAL DEVELOPMENT

C R D (AP EC) 611 Regional Impact Analysis 3(3,0) Techniques for analysis of the growth and decline of regions including economic-base theory, shift share, regional input-output, regional econometric models, and fiscal impact models. *Preq:* AP EC 202 or ECON 211 and 212.

C R D (AP EC) 612 Regional Economic Development Theory and Policy 3(3,0) Development of rural economic activity in the context of historical, theoretical, and policy aspects of friction associated with spatial separation. Location factors, transfer costs, location patterns, and regional-growth policy are considered. *Preq:* AP EC 202 or ECON 211 or equivalent.

C R D 692 Case Study Project 3(3,0) Capstone course engaging students in in-depth case study projects in community and economic development. Designed to enhance professional development, career interests, and practical experience. Students may participate in an internship, field experience, service learning activity, or investigation of a community, leadership, or economic development topic. *Preq:* C R D 336 and consent of instructor.

COMPUTER ENGINEERING

See courses listed under *Electrical and Computer Engineering*.

COMPUTER SCIENCE

CP SC 605 Introduction to Graphical Systems Design 3(3,0) Principles, computational techniques, and design concepts needed for designing systems for effective graphical displays. *Preq:* CP SC 212, 215, MTHSC 108, 311, with a C or better.

CP SC 611 Virtual Reality Systems 3(3,0) Design and implementation of software systems necessary to create virtual environments. Techniques for achieving real-time, dynamic display of photo-realistic, synthetic images are discussed. Includes hands-on experience with electromagnetically-tracked, head-mounted displays and requires, as a final project, the design and construction of a virtual environment. *Preq:* CP SC 405 with a C or better.

CP SC 612 Eye Tracking Methodology and Applications 3(3,0) Introduction to the human visual system; visual perception; eye movements; eye tracking systems and applications in psychology, industrial engineering, marketing, and computer science; hands-on experience with real-time, corneal-reflection eye trackers, experimental issues. Final project requires execution and analysis of an eye tracking experiment. *Preq:* CP SC 360 or PSYCH 310 or MKT 431.

CP SC 614 Human and Computer Interaction 3(3,0) Survey of human and computer interaction, its literature, history, and techniques. Covers cognitive and social models and limitations, hardware, and software interface components, design methods, support for design, and evaluation methods. *Preq:* CP SC 212 and 215 with a C or better, or equivalent.

CP SC 616 2-D Game Engine Construction 3(3,0) Introduction to the tools and techniques necessary to build 2-D games. Techniques draw from subject areas such as software engineering, algorithms, and artificial intelligence. Students employ techniques such as sprite animation, parallax scrolling, sound, AI incorporated into game sprites and the construction of a game shell. *Preq:* CP SC 212 and 215 with a C or better.

CP SC 620 Computer Security Principles 3(3,0) Covers principles of information systems security, including security policies, cryptography, authentication, access control mechanisms, system evaluation models, auditing, and intrusion detection. Computer security system case studies are analyzed. *Preq:* CP SC 322 and 360 with a C or better.

- CP SC 624 System Administration and Security 3(3,0)** Topics related to the administration and security of computer systems are covered. Primary emphasis is placed on the administration and security of contemporary operating systems. *Preq:* CP SC 360 and 332 or 422 with a C or better.
- CP SC 628 Design and Implementation of Programming Languages 3(3,0)** Overview of programming language structures and features and their implementation. Control and data structures found in various languages are studied. Runtime organization and environment and implementation models are also included. *Preq:* CP SC 231, 350, and 360 with a C or better.
- CP SC 655 Computational Science 3(3,0)** Introduction to the methods and problems of computational science. Course uses problems from engineering and science to develop mathematical and computational solutions. Case studies use techniques from Grand Challenge problems. Emphasizes the use of networking, group development, and modern programming environments. *Preq:* MTHSC 108, 311 and previous programming experience in a higher level language.
- CP SC 662 Database Management Systems 3(3,0)** Introduction to database/data communications concepts as related to the design of on-line information systems. Problems and solutions involving structuring, creating, maintaining, and accessing multiple-user databases are presented and solutions developed. Comparison of several commercially available teleprocessing monitor and database management systems is made. *Preq:* CP SC 360.
- CP SC 663 On-line Systems 3(3,0)** In-depth study of the design and implementation of transaction processing systems and an introduction to basic communications concepts. A survey of commercially available software and a project using one of the systems is included. *Preq:* CP SC 462.
- CP SC 664 Introduction to Computer Architecture 3(3,0)** Survey of von Neumann computer architecture at the instruction-set level. Fundamental design issues are emphasized and illustrated using historical and current mainframe, supermini and micro architecture. *Preq:* CP SC 330 or consent of instructor.
- CP SC 672 Software Development Methodology 3(3,0)** Advanced topics in software development methodology. Techniques such as chief programmer teams, structured design, and structured walk-throughs are discussed and used in a major project. Emphasis is on the application of these techniques to large-scale software implementation projects. Additional topics such as mathematical foundations of structured programming and verification techniques are also included. *Preq:* CP SC 360 and 372.
- CP SC 681 Selected Topics 1-3(1-3,0)** Areas of computer science in which nonstandard problems arise. Innovative approaches to problem solutions which draw from a variety of support courses are developed and implemented. Emphasis is on independent study and projects. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.
- CP SC 740 Computer Science for High School Teachers I 3(2,2)** Modern problem-solving and programming methods for high school teachers; algorithm development, software life cycle concepts, system hardware and software components, and an introduction to programming in PASCAL. Restricted to graduate students and in-service teachers in secondary education. *Preq:* Introductory computer programming.
- CP SC 801 Intensive Introduction to Computer Science for MFAC 5(3,2)** Fundamental concepts of computing for computer science graduate students who have no undergraduate degree in computing. Topics include object-orientated design and programming, computer organization, software development systems, data structures, and graphical user interfaces. Heavy emphasis is on laboratory and project work. *Preq:* Consent of instructor.
- CP SC 805 Advanced Modeling Techniques in Computer Graphics 3(3,0)** Advanced techniques used in the artificial rendering of natural scenes; current practice in computer graphics; full software implementation of each technique; extensive coding. *Preq:* CP SC 405.
- CP SC 807 3D Production Pipeline 3(3,0)** Immerses students in the world of 3-D computer graphics. Makes use of current industry-standard software. Topics include concept development, storyboarding, modeling, rigging, animation, texturing, lighting, rendering, particles, scripting, compositing, and editing. *Preq:* Digital Production Arts major or consent of instructor.
- CP SC 808 Computer Animation 3(3,0)** Scripting systems, motion control, articulated figures, forward and inverse kinematics, soft object deformation, inbetweening key deformations, morphing, animating analytical models. *Preq:* MTHSC 311 and CP SC 611 or consent of instructor.
- CP SC 810 Introduction to Artificial Intelligence 3(3,0)** Problem solving and game playing; knowledge representation; expert systems; natural language processing; perception and learning. *Preq:* Consent of instructor.
- CP SC 815 Special Effects Production 3(3,0)** Video special effects, compositing problems, effects animation, matchmoving and 3-D geometry, color and texture reconstruction from 2-D images; extensive use of scripting languages and high-end software platforms. *Preq:* CP SC 605 or 611 and ART 821 or consent of instructor.
- CP SC 820 Parallel Architecture 3(3,0)** Study of parallel processing issues including vector and pipeline processors, arrays of processing elements, associative processors, data flow computers, networks of processors. Also includes survey of parallel programming languages, design and implementation of parallel algorithms, and future trends. *Preq:* CP SC 664.
- CP SC 822 Case Study in Operating Systems 3(2,2)** Case study of the design of an operating system. Class periods are devoted to reviewing source code and deducing the structure of the system. Lab exercises require students to make major changes to the system to enhance its performance on particular workloads. *Preq:* CP SC 422, consent of departmental graduate affairs chair.
- CP SC 823 Operating Systems Design 3(3,0)** Analytic, simulation, and conceptual models of operating systems and their application to the design and implementation of actual systems; kernel design and its implementation in UNIX-like systems; models of concurrent processes, processor scheduling, and memory management. *Preq:* CP SC 423, MTHSC 401.
- CP SC 824 Advanced Operating Systems 3(3,0)** Recent trends in system design and implementation; operating system structures to support reliable secure systems; verification techniques; fault tolerant systems; operating system considerations for closely coupled multiprocessor systems; network operating systems. *Preq:* CP SC 623 or consent of instructor.
- CP SC 827 Translation of Programming Languages 3(3,0)** Theoretical foundations and algorithms for compiling and interpreting programming languages. Topics include lexical analysis, syntactic analysis, semantics analysis, optimization, and code generation. Implementation of a compiler or a major component of a compiler is normally a term project. *Preq:* CP SC 350, 428.
- CP SC 828 Theory of Programming Languages 3(3,0)** Syntax and semantics of programming languages; finite state and pushdown processors; context-free models of syntax; parsing algorithms and semantic models. *Preq:* CP SC 429, 450.
- CP SC 829 Advanced Compiler Topics 3(3,0)** Code generation, register allocation, program optimization, data flow, interprocedural operations, parallel compilation and distributed compilation. *Preq:* CP SC 429, 450.
- CP SC 830 Systems Modeling 3(3,0)** Fundamental concepts and techniques used in the stochastic modeling of computer and computer-based communication systems. Applications include hardware configuration design, software performance evaluation, and reliability estimation of fault-tolerant systems. *Preq:* CP SC 630 and MTHSC 400 or 800 or consent of instructor.
- CP SC 838 Advanced Data Structures 3(3,0)** Search trees; data structures for sets; index structures for data bases; data abstraction and automated implementation; implicit data structures; storage compaction of lists; data structures for decision trees; data structures in areas such as computer graphics, artificial intelligence, picture processing, and simulation. *Preq:* Consent of instructor.
- CP SC 839 Foundations of Theoretical Computer Science 3(3,0)** Preparation for the study of advanced issues in computational complexity, algorithm correctness, and inherent limits to computing; set theory and proof techniques; classes of the Chomsky hierarchy. *Preq:* CP SC 350 or consent of department chair.
- CP SC 840 Design and Analysis of Algorithms 3(3,0)** Basic techniques for design and analysis of algorithms; models and techniques for obtaining upper and lower time and space bounds; time/space trade-offs; inherently difficult problems. *Preq:* MTHSC 419 or CP SC 650 or equivalent.

- CP SC 851 Software Systems for Data Communications 3(3,0)** Structure of software systems supporting communications among computing devices having diverse processing and communication capabilities; characterization of data communications software in terms of unified network architectures consisting of several functional layers; evaluation of several network architectures. *Preq:* Consent of instructor.
- CP SC 852 Internetworking 3(3,0)** Network architecture and communication protocols underlying the global interoperability of the Internet. Topics include addressing and routing, interconnection of autonomous networks, naming and name resolution, connection management, flow and congestion control, and network management. *Preq:* CP SC 851, E C E 638, or consent of instructor.
- CP SC 853 Implementation of TCP/IP Protocols 3(3,0)** Case study of the architecture of a widely-used implementation of the TCP/IP protocol stack. Source code reviews illustrate layered design and use of core kernel services. Student projects include implementation of a complete IP transport protocol. *Preq:* CP SC 822 and 852, or consent of instructor.
- CP SC 854 Performance Analysis of Internet Protocols 3(3,0)** Analyzes network performance, focusing on experimental methods and current Internet protocols. Covers random processes, time series analysis, and simulation concepts. Incorporates experimental-based research in computer networking. *Preq:* CP SC 852 or consent of instructor.
- CP SC 855 Embedded Network Systems 3(3,0)** Discusses hardware fundamentals, technology applications, operating systems, programming platforms, software design and implementation, energy conservation techniques, self-stabilization paradigm, routing algorithms, clustering algorithms, time synchronization algorithms, and sensor-actuator integration. *Preq:* Consent of instructor.
- CP SC (ART) 860 Studio Computer Research 3-15(0,6-30)** See ART 860.
- CP SC 862 Database Management System Design 3(3,0)** Concepts and structures for design and implementation of a DBMS; theoretical foundations for query systems; data modeling and information representation; user interface and internal system design considerations; system performance modeling and measurement; topics from the literature. *Preq:* CP SC 462.
- CP SC 863 Multimedia Systems and Applications 3(3,0)** Principles of multimedia systems and applications; techniques in effectively representing, processing, and retrieving multimedia data such as sound and music, graphics, image, and video; operating system and network issues in supporting multimedia; advanced topics in current multimedia research. Term project requires implementing some selected components of a multimedia system. *Preq:* Consent of instructor.
- CP SC 865 Data Mining 3(3,0)** Study of principles of data mining: concepts and techniques of data analysis including regression, clustering, classification, association, prediction, etc.; efficient data mining algorithms; data mining applications in various areas including market analysis and management, WWW mining, bioinformatics, etc. Course projects for designing and using data mining algorithms in the applications are required. *Preq:* Knowledge of statistics and database systems or consent of instructor.
- CP SC 870 Software Design 3(3,0)** Fundamental concepts of object modeling using object-oriented analysis and design; realistic application of software engineering principles within a variety of problem domains; mainstream language with facilities for object-training programming. *Preq:* Proficiency in programming in a procedural language.
- CP SC 871 Foundations of Software Engineering 3(3,0)** Techniques and issues in software design and development; tools, methodologies, and environments for effective design, development, and testing of software; organizing and managing the development of software projects. *Preq:* Graduate standing in Computer Science.
- CP SC 872 Software Specification and Design Techniques 3(3,0)** Techniques, tools, environments, and formal methods for software specification and design; verification of design correctness. *Preq:* CP SC 672 or equivalent.
- CP SC 873 Software Verification, Validation, and Measurement 3(3,0)** Proofs of correctness; test planning; static and dynamic testing; symbolic execution; automated testing; verification and validation over the software life cycle; software metrics; software maintenance. *Preq:* CP SC 672 or equivalent.
- CP SC 875 Software Architecture 3(3,0)** Creation, analysis, and maintenance of architectures for software systems. Basic principles, patterns, and techniques. Quality attributes of the architecture are used to make a quantitative analysis. Students create and analyze two architectures from different domains.
- CP SC 881 Selected Topics 1-3(1-3,0)** Advanced topics from current problems of interest in computer science. Topics vary from semester to semester. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.
- CP SC 888 Directed Projects in Computer Science 1-6** Directed individual project supervised by department faculty. To be taken Pass/Fail only.
- CP SC 891 Master's Thesis Research 1-12**
- CP SC 940 Topics in Advanced Algorithms 3(3,0)** Study of selected topics in advanced algorithms drawn from graph algorithms (network flows, matchings, cuts, planarity testing), approximation algorithms (traveling salesman, linear relaxation techniques), distributed algorithms (mutual exclusion, synchronization, self-stabilization), parallel algorithms (parallel prefix, models, sorting), or randomized algorithms (sampling, probabilistic methods, random walks). May be repeated for a maximum of nine credits, but only if different topics are covered. *Preq:* CP SC 840 or consent of instructor.
- CP SC 950 Selected Topics in Computer Science 1-3(1-3,0)** Study of advanced topics from current problems of interest in computer science. May be repeated for a maximum of 12 credits, but only if different topics are covered. To be taken Pass/Fail only.
- CP SC 951 Seminar in Algorithms 1-3(1-3,0)** Advanced topics from current problems of interest in algorithms. May be repeated for credit.
- CP SC 953 Seminar in Database Systems 1-3(1-3,0)** Advanced topics from current problems of interest in database systems. May be repeated for credit.
- CP SC 955 Seminar in Programming Languages 1-3(1-3,0)** Advanced topics from current problems of interest in programming languages. May be repeated for credit.
- CP SC 957 Seminar in Software Engineering 1-3(1-3,0)** Advanced topics from current problems of interest in software engineering. May be repeated for credit.
- CP SC 981 Seminar in Computer Science 1-3(1-3,0)** Topics of current research interest. May be repeated for credit.
- CP SC 991 Doctoral Dissertation Research 1-12**
- ## CONSTRUCTION SCIENCE AND MANAGEMENT
- C S M 655 Reducing Adversarial Relations in Construction 3(3,0)** Focuses on the delivery of projects and how adversarial relations can affect the successful completion of the venture. Topics include management of human resources, understanding needs and processes of the participants, where problems lie, methods of avoiding and settling disputes. *Preq:* Construction Science and Management or Architecture major, senior standing, or consent of department chair.
- C S M 852 Construction Management Research 3(3,0)** Research methodology applied to the construction industry. *Preq:* Consent of instructor.
- C S M 860 Construction Financial Planning and Analysis 3(3,0)** Theory of financial management as it relates to the financial challenges faced by the construction firm.
- C S M 861 Construction Control Systems 3(3,0)** Development and analysis of cost, resource, and quality control programs for a company's construction projects.
- C S M 862 Personnel Management and Negotiations 3(3,0)** The role of management and unions in the construction industry. Topics include contract negotiation, collective bargaining, dispute resolution, and management for productivity improvement. *Preq:* Consent of instructor.
- C S M 863 Advanced Planning and Scheduling 3(3,0)** Analysis and control of construction projects using advanced techniques for planning, scheduling, and resources control. *Preq:* Consent of instructor.
- C S M 864 Construction Business Strategy and Marketing 3(3,0)** Techniques for business strategy development and marketing of various types of construction companies.

- C S M 865 Project Management 3(3,0)** Theory of project administration and control with special emphasis on the role and responsibilities of the project manager.
- C S M 866 Contractor Role in Development 3(3,0)** Addresses the various roles and responsibilities of the contractor in development including discussion of the owner/designer/constructor relationship. Does not count toward Master's in Construction Science and Management degree requirements. *Preq:* Consent of instructor.
- C S M 881 Professional Seminar 3(3,0)** New and emerging methods for management of the construction or construction-related firm. *Preq:* Consent of instructor.
- C S M 889 Special Problems 3(3,0)** Research design problem on a construction-related topic.
- C S M 890 Directed Studies 3-6** Special topics not covered in other courses. Emphasis is on field studies, research activities, and current developments in building science. *Preq:* Consent of instructor.
- C S M 891 Master's Thesis Research 1-9** With approval of the advisory committee, students carry out independent research and analysis. Thesis is presented orally and in writing and in strict compliance with the guidelines of the Graduate School.

CROP AND SOIL ENVIRONMENTAL SCIENCES

- CSENV 603 Soil Genesis and Classification 2(1,3)** Soil morphology and characterization, pedogenic processes, soil-forming factors, and classification of soils. Offered fall semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 604 Soils and Land Use 2(1,3)** Soils interpretations for nonagricultural purposes and facilities. Emphasizes use of modern soil surveys; properties and features of soils important in nonfarm land uses. Not open to Crop and Soil Environmental Sciences minors or to students who have taken CSENV 202. Offered fall semester only.
- CSENV 605 Plant Breeding 3(2,2)** Application of genetic principles to the development of improved crop plants. Principle topics include the genetic and cytogenetic basis of plant breeding, mode of reproduction, techniques in selfing and crossing, methods of breeding, inheritance in the major crops, and biometrical methods. Offered spring semester only. *Preq:* GEN 302 or equivalent.
- CSENV 607 Introductory Weed Science 3(2,2)** Weed management in crops and pastures of the Southeast. Topics include weed identification, herbicide families and modes of action, herbicide formulations, herbicide diagnosis on crops and weeds, sprayer calibration and spray application, and nonchemical weed control strategies. *Preq:* AGRIC 104 or consent of instructor.
- CSENV (B E) 608 Land Treatment of Wastewater and Sludges 3(3,0)** Principles for designing environmentally acceptable land application systems using municipal and industrial wastewater and sludges are presented. Topics include land-limiting constituent analysis; soil-plant interactions; system equipment and design; system operation and management; public acceptance, social, and regulatory issues. Case studies and field trip(s) are planned. *Preq:* Senior standing in agriculture or engineering or consent of instructor.
- CSENV 617 Weed Morphology and Ecology 3(2,2)** Study of the morphological characteristics of weed plants of economic importance in row crops, pastures, and turf of South Carolina. Succession, reproduction, dissemination, distribution, competition, and allelopathy are discussed. *Preq:* CSENV 407 or HORT (CSENV) 433 or consent of instructor.
- CSENV 621 Principles of Field Crop Production 3(3,0)** Principles for production of field crops. Topics include botany and physiology, tillage, harvesting, storage, and crop quality. Principles are illustrated using examples from various crops. Offered fall semester only. *Preq:* AGRIC 104 or equivalent introductory plant science, CSENV 202.
- CSENV 622 Major World Crops 3(3,0)** Examines the distribution, adaptation, production, and utilization of major agronomic crops of the world. Emphasizes crops important to U.S. agriculture. Specific crops discussed in more detail include corn, wheat, rice, sorghum, soybean, cotton, tobacco, and peanuts. Offered spring semester only. *Preq:* AGRIC 104 or equivalent introductory plant science, CSENV 202.
- CSENV 623 Field Crops—Forages 3(3,0)** Establishment, management, and utilization of forage crops in a forage-livestock agro-ecosystem context. Hay, silage, and pasture utilization are discussed. Computer model is used to study complexity of forage-livestock production systems. *Preq:* AGRIC 104, CSENV 202, or consent of instructor.
- CSENV 624 Applied Aspects of Forage Management 1(0,2)** Hands-on exposure to forage plantings, establishment, and management practices. Pasture and harvested forage systems, equipment and practices; analysis of forage-livestock systems. *Preq:* CSENV 423 (or concurrent enrollment).
- CSENV 625 Seed Science and Technology 3(2,2)** Topics include seed development, germination, dormancy, pathology, storage, and deterioration. Seed testing and commercial production of seed are also covered. Emphasis is on useful applications of current seed science knowledge. Offered spring semester of even-numbered years only. *Preq:* AGRIC 104, BIOSC 205.
- CSENV (AP EC) 626 Cropping Systems Analysis 3(2,2)** Application of agronomic and economic principles in solving problems relating to the production and marketing of agronomic crops. Major part of the course is a case study in which detailed analysis of a farm, agribusiness, or environmental situation is made with students making formal written and oral presentations of results. Offered fall semester only. *Preq:* AGRIC 104, AP EC 202, Junior standing.
- CSENV (HORT) 633 Landscape and Turf Weed Management 3(2,2)** See HORT 633.
- CSENV 646 Soil Management 3(3,0)** Basic soil properties are related to compaction, water and solute movement, and root growth. Practical management problems are considered and solutions developed based on basic soil characteristics. Problems include erosion, no-tillage, compaction, irrigation, leaching, waste application, golf-green management, and orchard establishment. Offered fall semester only. *Preq:* CSENV 202.
- CSENV 652 Soil Fertility and Management 3(3,0)** Soil properties, climatic factors, and management systems in relation to soil fertility maintenance for crop production; plant nutrition and growth in relation to crop fertilization and management. Offered spring semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 653 Soil Fertility Laboratory 1(0,3)** Evaluation and interpretation of soil fertility production. Offered spring semester only. *Preq:* CSENV 202 or consent of instructor.
- CSENV 675 Soil Physics and Chemistry 3(2,3)** Study of the principles of soil physics and chemistry and their applications. Topics include soil texture, structure, compaction, water relations, solute movement, mineral composition, adsorption phenomenon, and soil acidity. Offered fall semester only. *Preq:* CH 101, CSENV 202, PHYS 207.
- CSENV (ENTOX) 685 Environmental Soil Chemistry 3(3,0)** Study of soil chemical processes (sorption, desorption, ion exchange, precipitation, dissolution, and redox reactions) of nutrients and inorganic and organic contaminants in soils and organic matter. Chemical complex equilibria and adsorption phenomena at the solid (soil, sediment, and mineral) water interface are emphasized. *Preq:* CSENV 202, CH 102 or consent of instructor.
- CSENV 690 Beneficial Soil Organisms in Plant Growth 3(3,0)** Aspects of biological nitrogen fixation, mycorrhizal fungi, microbial-pesticide interactions, bioremediation, nutrient cycles, and biological pest control related to plant growth, soil/environmental quality, and sustainable agriculture. Students who desire laboratory experience in these topics may register for CSENV 406 after consultation with instructor. Offered spring semester only. *Preq:* CSENV 202, MICRO 305, PL PA 401, or consent of instructor.
- CSENV 701 Soils and Man 3(3,0)** Different kinds of soils, their properties, uses, management, conservation, and relationship with the environment and other human endeavors.
- CSENV 801 Crop Physiology and Nutrition 3(3,0)** Basic concepts and physiologic aspects of growth and culture applied to crop management practices. Offered fall semester of odd-numbered years only. *Preq:* BIOSC 401, 402; or equivalent.
- CSENV 802 Pedology 3(3,0)** Current concepts and theories in soil genesis and morphology; advanced study of soil taxonomy. Offered fall semester of odd-numbered years only. *Preq:* CSENV 403.

CSENV 804 Theory and Methods of Plant Breeding 3(3,0) Concepts and principles of plant breeding and genetics as applied to development and maintenance of improved crop varieties; theoretical considerations of various breeding methods. Offered fall semester of even-numbered years only. *Preq:* CSENV 405, EX ST 801, or consent of instructor.

CSENV 805 Soil Fertility 3(3,0) Soil properties affecting nutrient availability and plant growth; inventory of major soil groups with reference to plant stress features; behavior of essential elements in soils in relation to plant availability; current soil fertility research. Offered spring semester of even-numbered years only. *Preq:* CSENV 403 or 452 or consent of instructor.

CSENV 806 Special Problems 1-3(0,3-9) Research not related to a thesis.

CSENV 807 Soil Physics 4(3,3) Principles and applications of transport of water and solutes in soils emphasizing unsaturated flow phenomenon. Offered fall semester of even-numbered years only. *Preq:* MTHSC 108 or equivalent.

CSENV 808 Soil Chemistry 3(2,3) Principles and theories concerning the structure and chemical properties of soil colloids, ion exchange and surface phenomena, chemical equilibria, soil acidity, and oxidation-reduction reactions. Offered fall semester of odd-numbered years only.

CSENV 810 Soil Microbiology 3(3,0) Biological nitrogen fixation, mycorrhizal fungi, and pesticide interactions in soils with emphasis on microbial-plant-soil relationships. Offered fall semester of even-numbered years only. *Preq:* CSENV 690 or MICRO 610 and consent of instructor.

CSENV 812 Crop Ecology and Land Use 3(3,0) Concepts and factors affecting adaptation and distribution of crop plants; microclimate and crop response to environmental factors with modifications of microclimate by agricultural operations; interactions among crop plants and between weeds and crop plants under field conditions. Offered fall semester of even-numbered years only.

CSENV (PES) 850 Agricultural Biotechnology 2(2,0) Fundamentals of biotechnology for students specializing in applied life sciences. Scientific principles, limitations, novel concepts, and wide-ranging applications of biotechnology to agricultural industry.

CSENV 890 Special Topics in Agronomy 1-3(1-3,0) Group discussion of recent developments in agronomic research. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

EARLY CHILDHOOD EDUCATION

ED EC 800 Parent Education in Early Childhood Multicultural Settings 3(3,0) Focuses on a multicultural perspective on parent involvement in early childhood education settings. Theory and applications of parent involvement in multicultural environments are studied with an emphasis on activities that set the stage for science and math concept development and on uses of technology with young children.

EDEC 810 Advanced Early Childhood Education Foundations and Methods 3(3,0) In-depth study of developmentally appropriate and effective instructional methods in early childhood classrooms and the history of early childhood education as a professional field.

ED EC 820 Advanced Early Childhood Education Curriculum 3(3,0) In-depth study of curriculum development and current approaches in the field of early childhood education. Students explore the research literature on effective curriculum in early childhood education at both the national and international levels. *Preq:* Consent of instructor.

ED EC 840 Theories of Early Childhood Education 3(3,0) Examines the theoretical, philosophical, and research foundations of early childhood education with emphasis on how these foundations interact with science, math, and technology concept development in young children. Students develop skills in critical inquiry as they explore specific topics related to early child care and education.

EDEC 850 Creative and Cognitive Development in Early Childhood: Creating Connections to Math and Science 3(3,0) Examines the theoretical, philosophical, and cognitive foundations of creative thought during the early childhood years. Students develop skills in critical inquiry as they explore the connections between creativity and math/science education during the early childhood years.

ED EC 880 Current Issues in Early Childhood 3(3,0) Focuses on factors that impact early childhood policy, identification of current problems/issues, and development of research-based advocacy strategies.

ED EC 885 Thesis Hours in Early Childhood Education 3(3,0) Students work with thesis advisor and committee to complete thesis requirements; thesis must address a STEM discipline. Required of students enrolled in thesis track in Early Childhood Education. May be repeated for a maximum of six credits. *Preq:* 18 credit hours including ED F 778, 879; consent of thesis advisor.

ED EC 890 Assessment and Program Planning in Early Childhood 3(3,0) Study of instructional planning and assessment for young children in all content areas including math, science, and technology. Also explores multiple assessment and screening strategies for infants, toddlers, and preschool children with typical and atypical development; includes quantitative and qualitative assessment methods for program planning.

ED EC 895 Integrating Math, Science, and Technology in Inclusive Early Childhood Settings 3(3,0) Emphasizes theory to practice and exploration of developmentally appropriate strategies for integrating math, science, and technology into the overall early childhood curriculum.

ECONOMICS

ECON 605 Introduction to Econometrics 4(3,3) Introduction to the methods of quantitative analysis of economic data. Reviews basic statistical methods and probability distribution. Topics include data management using professional statistical software applications; multiple regression analysis; hypothesis testing under conditions of multicollinearity, heteroscedasticity, and serial correlation. *Preq:* ECON 211 and 212; MTHSC 108 or 207; EX ST 301 or MTHSC 301 or 309.

ECON 606 Advanced Econometrics 3(3,0) Reviews statistical inference using multiple regression (OLS) analysis and model specification. Topics include multicollinearity; heteroscedasticity and serial correlation; two-stage least squares and instrumental variables models; simultaneous equations models; limited dependent variable models using maximum likelihood estimation and time-series analysis; and presentation of results in technical writing. *Preq:* ECON 405 or consent of instructor.

ECON 610 Economic Development 3(3,0) Consideration and analysis of economic and related problems of underdeveloped countries. Attention is given to national and international programs designed to accelerate solution of these problems. *Preq:* ECON 314 or consent of instructor.

ECON 611 Economics of Education 3(3,0) Analysis of economic issues related to education. The decision to invest in education, elementary and secondary school markets and reform, the market for college education, teacher labor markets, and education's effects on economic growth and income distribution. *Preq:* ECON 314 or consent of instructor.

ECON 625 Antitrust Economics 3(3,0) Analysis of economic and legal issues created by the exercise of market power. The motivation and execution of government policy toward mergers, predatory conduct, and various restraints of trade are extensively examined. *Preq:* ECON 309 or 314 or consent of instructor.

ECON 626 Seminar in Sports Economics 3(3,0) Economic analysis of sports teams, leagues, and institutions. Topics include antitrust issues, public funding of sports venues, labor relations, wagering markets, athlete compensation, and application of economic principles to sports settings. Empirical research project is cornerstone of course. *Preq:* ECON 314 and 405 or consent of instructor.

ECON 628 Cost-Benefit Analysis 3(3,0) Develops techniques for the appraisal of public expenditure programs with particular emphasis on investment in infrastructure. Topics include the choice of an appropriate discount rate and the calculation of social costs and benefits in the presence of market distortions. *Preq:* ECON 314 or consent of instructor.

ECON 640 Game Theory 3(3,0) Introduction to the formal analysis of strategic interaction among rational, self-interested rivals. Basic theoretical aspects of games are discussed and applied to such topics as bargaining, voting, auctions, and oligopoly. *Preq:* ECON 314 and MTHSC 106, or ECON 430, or consent of instructor.

- ECON 655 Applied Microeconomic Research 3(3,0)** Students conduct research in applied microeconomics. Topics vary according to student and professor interests. Students read papers in the literature, formulate their own economic hypotheses, and collect and analyze data to test those hypotheses. May be repeated for a maximum of nine credits. *Prq:* ECON 314 or consent of instructor.
- ECON 751 Selected Topics for Teachers 3(3,0)** Current economic policy issues such as inflation, regulation, protectionism, and energy policy. Emphasis is on the presentation of these topics to secondary school students. Topics vary from year to year. May be repeated for credit. *Prq:* ECON 200, 211.
- ECON (AP EC) 800 History of Economic Thought 3(3,0)** Development of economic thought from early Greek to Keynesian economics; writings of major economists such as Smith, Ricardo, Marx, Marshall, and Keynes; development of major economic theories.
- ECON (AP EC) 801 Microeconomic Theory 3(3,0)** Microeconomic theory and its use to analyze and predict the behavior of industries, firms, and consumers under various market conditions. Offered fall semester only.
- ECON (AP EC) 802 Advanced Economic Concepts and Applications 3(3,0)** Rigorous development of price theory under alternative product and resource market structures. *Prq:* Consent of instructor.
- ECON (AP EC) 804 Applied Mathematical Economics 3(3,0)** See AP EC 804.
- ECON 805 Macroeconomic Theory 3(3,0)** Macroeconomic theory involving static and dynamic models and their use in analysis of economic problems and policies.
- ECON (AP EC) 806 Econometrics I 3(3,0)** See AP EC 806.
- ECON 807 Econometrics II 3(3,0)** Economic models expressed as systems of equations; problems of identification, parameter estimation, measurement errors, and statistical inference; techniques of simulation, forecasting, model validation, and interpretation. Offered fall semester only.
- ECON (AP EC) 808 Econometrics III 3(3,0)** Continuation of ECON 807. Covers current economic models and estimation procedures. Offered spring semester only. *Prq:* ECON 807.
- ECON (AP EC) 809 Advanced Natural Resource Economics 3(3,0)** See AP EC 809.
- ECON (AP EC) 810 Natural Resources Management and Policy 3(3,0)** See AP EC 810.
- ECON (AP EC) 811 Economics of Environmental Quality 3(3,0)** Pricing and distribution emphasizing effects upon economic welfare; goods allocated by government purchase for joint consumption and those distributed by rationing; alternate plans for allocating public goods. Offered fall semester of even-numbered years only. *Prq:* ECON 314 or equivalent.
- ECON (AP EC) 816 Labor Economics 3(3,0)** Wage and employment theory; labor markets; labor history; current problems in labor and manpower economics.
- ECON (AP EC) 817 Advanced Production Economics 3(3,0)** See AP EC 817.
- ECON (AP EC) 820 Public Finance 3(3,0)** Impact of government on resource allocation, income distribution and stability; role of regulation; principles of taxation.
- ECON 821 Public Choice 3(3,0)** Economic theory to analyze collective decisions. Topics include the pure theory of collective choice and applied analyses of democratic governments and their policy processes.
- ECON (AP EC) 822 Contemporary Public Policy 3(3,0)** See AP EC 822.
- ECON 823 Microeconomics for Public Policy 3(3,0)** Economic aspects of public policy making; individual behavior as governed by the market and other incentive mechanisms. Equips students with methodological tools for evaluating public policies. *Prq:* Admission to the Policy Studies program or consent of instructor.
- ECON (AP EC) 824 Organization of Industry 3(3,0)** The structure of markets and firms; forces that determine the size of firms and the boundaries of markets; the behavior of firms, both singly and in concert, to exploit market positions.
- ECON 825 Antitrust Economics 3(3,0)** Theoretical analysis of monopoly, monopolizing practices, and the exercise of market power. Study of government policy towards mergers, predation, and restraints of trade. *Prq:* ECON (AP EC) 801.
- ECON (AP EC) 826 Economic Theory of Government Regulation 3(3,0)** The scope of governmental regulation in the economy of the United States, its evolution and development; the application of the tools of economic analysis to the issues of regulated enterprise. *Prq:* ECON 314 or equivalent.
- ECON (AP EC) 827 Economics of Property Rights 3(3,0)** Analyzes the evolution and impact of various property rights institutions on individual behavior and the subsequent use of resources. Particular attention is paid to the importance of property rights structures in the organization of business and in managerial decision making. *Prq:* ECON 801.
- ECON (AP EC) 828 Market Structure in Agricultural Industries 3(3,0)** See AP EC 828.
- ECON (AP EC) 831 Economic Development 3(3,0)** Economic analysis of development of urban areas within the system of cities; central place theory and general equilibrium models of interregional economic activity emphasizing central place systems, spatial interaction and stochastic processes; internal development of the city focusing on housing and land use patterns, transportation, and urban form.
- ECON (AP EC) 832 Community and Regional Economics 3(3,0)** See AP EC 832.
- ECON 836 Research in Economics of Education 3(3,0)** Theoretical and econometric analysis of education including such topics as human capital theory, pricing and competition in higher education, public financing and provision of education, cost/benefit analyses of education reforms such as accountability, school finance equalization, and school choice. Includes discussion and research on current topics in the economics of education. *Prq:* AP EC (ECON) 806 or consent of instructor.
- ECON (AP EC) 840 International Trade Theory 3(3,0)** Theory of free trade from Ricardo to the present; theory and application of optimal and second-best tariffs; recent empirical testing of trade and tariff theory. *Prq:* ECON 314 and (AP EC) 802 or consent of instructor.
- ECON (AP EC) 841 International Finance 3(3,0)** Financial economics of decision making in a multinational environment featuring autonomous governments and multiple currencies. Typical topics include the macroeconomic problems of unemployment and inflation in an international economy, management of exchange rate risk, credit risk, political risk, and taxation. *Prq:* ECON 315 or equivalent.
- ECON 845 Advanced Game Theory 3(3,0)** Introduces central concepts in game theory, emphasizing economic problems involving strategic behavior by consumers, firms, and governments. Covers static and dynamic games, with both complete and incomplete information. Specific topics may include oligopoly, bargaining, auction theory, mechanism design, repeated games, and information transmission.
- ECON (AP EC) 855 Financial Economics 3(3,0)** Study of modern theory of corporate finance. Includes basic theories of efficient markets, portfolio selection, capital asset pricing, option pricing, and agency costs. *Prq:* ECON (AP EC) 801 or consent of instructor.
- ECON 888 Directed Reading in Economics 1-3(1-3,0)** Directed reading and research in the student's field of interest. May be repeated for a maximum of three credit.
- ECON 891 Master's Thesis Research 1-12**
- ECON (AP EC) 899 Selected Topics 1-3(1-3,0)** See AP EC 899.
- ECON 900 Selected Topics in Economics 3(3,0)** Current topics in economic theory and empirical research. May be repeated for credit, but only if different topics are covered.
- ECON (AP EC) 901 Price Theory 3(3,0)** Neoclassical paradigm of market price and quantity; rigorous consideration of consumer behavior, the theory of the firm and market equilibrium, production and resource demands, and the supply of resources. *Prq:* ECON (AP EC) 801 or equivalent.
- ECON 905 Advanced Macroeconomic Issues 3(3,0)** Current unsettled issues in macroeconomic analysis. Topics include disequilibrium macro models, macro models of open economies, rational expectations and its critics, government stabilization policies and the controversy surrounding the concept of Ricardian equivalence. *Prq:* ECON 805 or equivalent.
- ECON (AP EC) 906 Seminar in Area Economic Development 3(3,0)** See AP EC 906.
- ECON 909 Time-Series Econometrics 3(3,0)** Introduces methods and models of time-series analysis. Reviews statistical concepts and introduces unique aspects of time-series data. Covers models useful for estimation, forecasting, and inference in macroeconomics and finance. Topics include autoregressive-moving average models, their multivariate generalization, nonlinear models of conditional heteroskedasticity, regime-switching models, and nonstationary processes. *Prq:* ECON 807.

ECON 911 Problems in Price Theory 3(3,0)

Price theory problems and exercises in preparation for standing the comprehensive examination preliminary to admission to candidacy to the PhD degree in Applied Economics. May be repeated up to three times.

ECON 915 General Equilibrium and Economic Growth 3(3,0)

Risk sharing and efficient allocations are presented. Basic aggregation theory is covered producing the representative agent model. The neoclassical growth model with and without technological progress is presented, followed by the endogenous growth model. The modifications to this model produce multiple development regimes, convergence, biconvergence, and switching phenomena. *Prereq:* ECON 805

ECON 916 Advanced Economic Growth 3(3,0)

Alternative models of endogenous growth are developed, including the public education models of growth, endogenous technology-R&D models, international trade and diffusion models, public policies and institutions, geography and growth, and finance and growth. Particular focus is on the empirical applications of growth models. *Prereq:* ECON 915.

ECON (AP EC) 917 Advanced Seminar in Labor Economics 3(3,0)

Continuation of ECON 816, bridging the gap between theory and modern empirical research in labor economics. Emphasizes reading recent empirical research papers to understand the techniques of modern research in labor economics. *Prereq:* ECON (AP EC) 816.

ECON 920 Empirical Public Economics 3(3,0)

Studies the effects of taxation on household and firm behavior, public goods, income transfer, and welfare policies. Considers fiscal federalism, public policy, and economic growth. Includes selected topics on effects of legislation and institutions on economic outcome. *Prereq:* ECON (AP EC) 801, 807, (AP EC) 820.

ECON 924 Advanced Industrial Organizations 3(3,0)

Coverage of advanced concepts and methods involving strategic interaction among firms. Topics may include pricing, capacity choice, advertising, collusion, and industry dynamics. *Prereq:* ECON (AP EC) 824 or consent of instructor.

ECON (AP EC) 950 Monetary Economics 3(3,0)

Economic analysis of money in our economy and effects of monetary policy on prices, interest rates, output, and employment.

ECON 980 Workshop in Applied Economics 3(3,0)

Forum for presentation and critical evaluation of ongoing research by candidates for the PhD degree in Applied Economics. May be repeated for a maximum of nine credits. *Prereq:* Consent of instructor.

ECON (AP EC) 991 Doctoral Dissertation Research 1-12 See AP EC 991.**EDUCATION**

ED 641 Middle School Curriculum 3(3,0) Concepts and methods for teaching middle school students. Discusses nature of middle school students, teacher characteristics, curricular and co-curricular programs, organization, and teaching.

ED (CTE) 700 Supervising the Student Teacher in the Public School 2-3(2-3,0)

Knowledge and skills desirable for supervisors of student teachers; use of observation instruments for recording objective data and evaluating teaching performance. To be taken Pass/Fail only. *Prereq:* Professional teaching certificate, at least one year of teaching experience, recommendation from employing school district, or consent of instructor.

ED 735 Teacher Professional Development: Selected Topics 1-3(1-3,0)

Selected topics determined by professional-development needs for teachers. Does not count toward a master's degree; for professional development credit only. May be repeated, but only if different topics are covered.

ED 738 Selected Topics in Education 1-3(1-3,0)

Specific master's-level topics not found in other courses are selected for in-depth study. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 739 Independent Study in Education 1-3(1-3,0)

Master's-level study of selected topics under the direction of a faculty member chosen by the student. Student and faculty member develop a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 745 Integrating Arts into the Curriculum 3(3,0)

Series of workshops introducing the integration of drama, music, dance, visual arts, and creative writing with academic subjects in the classroom. Includes review of research on the impact of arts education on student achievement, engagement, and school culture.

ED 839 Introduction to Linguistics 3(3,0)

Introduction to linguistics, including the subfields of syntax, morphology, phonology, semantics, pragmatics, and sociolinguistics. Also includes the study of writing systems and applications to literacy, language acquisition, and language contact and change. *Prereq:* Graduate standing in Education or consent of instructor.

ED 860 Classroom Action Research 3(3,0)

Develops skills for doing research in a K-12 setting on instructional methodology and/or curriculum. Study of research literature, research methods, and IRB procedures. Includes classroom action research project. *Prereq:* Teaching certification, admission to MEd degree program, ED F 778, 808, or consent of instructor.

ED (AG ED, CTE) 889 Research in Education 3(3,0) See AG ED 889.**ED (ED F, ED SP) 894 Directed Research 1-4(1-4,0)**

Research in a line of inquiry in education under the direction of faculty. Specific educational question is investigated and reported using appropriate methodology. To be taken Pass/Fail only. *Prereq:* ED F 778, 808 or consent of instructor.

ED 901 Selected Topics Doctoral Study 1-3(1-3,0)

Doctoral-level education topics not covered in other courses are selected for in-depth study and research. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 902 Independent Doctoral Study 1-3(1-3,0)

Study of selected topics in education under the direction of a faculty member chosen by the student. Student and faculty member develop a course of study different from any existing courses and designed for the individual student. May be repeated for a maximum of 24 credits, but only if different topics are covered.

ED 938 Grant Development in Education-Related Fields 3(3,0)

Addresses the process for writing and submitting grant proposals, including training grants, demonstration projects, research grants, and curriculum development projects.

ED 954 Curriculum Theory 3(3,0)

Main currents of curriculum theory in American education. *Prereq:* ED EL 760.

ED 955 Theoretical Bases of Instruction 3(3,0)

Seminar in the application of learning theory to instructional practice emphasizing instructional strategies in the classroom.

ED (ED F, ED SP) 980 Internship in Curriculum and Instruction 1-6(0,3-18)

Practical experiences linking the student's program of study to his/her field of professional service. To be taken Pass/Fail only. *Prereq:* Consent of advisor.

ED (ED F, ED SP) 991 Doctoral Dissertation Research 1-18**EDUCATIONAL COUNSELING (Counselor Education)****ED C 764 Theoretical and Practical Application of Student Development and Leadership in a University Setting 3(3,0)**

Development of leadership, programming, problem-solving, conflict-resolution, confrontation, and referral skills; legal and ethical issues and the implications for practitioners; comparative studies of housing programs and utilization of resources and support services available on the campus.

ED C 801 Foundations of Professional School Counseling 3(3,0)

Theory and practice of school counseling; principles and policies underlying programs.

ED C 803 Student Development Services in Higher Education 3(3,0)

Pupil personnel services offered by institutions of higher education.

ED C 804 Theories of Student Development in Higher Education 3(3,0)

Developmental aspects of the young adult age group and the relationship to postsecondary schools and training programs.

ED C 805 Community Counseling 3(3,0)

History and description of various counseling services provided in agency settings; the type of client populations served and existing legislative acts mandating these services.

ED C 806 Student Affairs Issues 3(3,0)

Introduction to the current issues in the student personnel profession and future challenges facing student affairs departments. *Prereq:* ED C 803, 804, or consent of instructor.

ED C 807 Counseling Children and Adolescents 3(3,0) Theory and techniques in the area of counseling youth in educational institutions and other settings; history and definition of disordered behavior, the etiology and occurrence of childhood disorders, developmental context, classification and assessment, and treatment issues. *Preq:* ED F 701, ED C 801, 810, or consent of instructor.

ED C 808 Legal and Ethical Issues in Student Affairs Practice and Counselor Education 3(3,0) Study of current legal and ethical issues confronting counselor educators and administrators working in student affairs practice and student affairs counseling. Examines a representative sample of key concepts, federal, and state court cases and explores the application of legal and ethical issues to student affairs practice and counseling.

ED C 809 Program Administration and Leadership in Higher Education 3(3,0) Process of organizing the personnel and financial resources needed to meet student development and institutional goals and objectives effectively. *Preq:* Consent of instructor.

ED C 810 Theories and Techniques of Counseling 3(3,0) Counseling theories and techniques. *Preq:* ED C 801 or consent of instructor.

ED C 811 Multicultural Counseling 3(3,0) Responsibility of counselors to all people regardless of race, sex, gender, socioeconomic status, subculture, etc.; content and theory related to counseling multicultural individuals/groups.

ED C 812 Career Counseling 3(3,0) Gathering, interpreting, and utilizing educational, social, and occupational information; techniques used in placement, survey, and follow-up.

ED C 813 Appraisal Procedures 3(2,2) Experience in gathering, interpreting, and utilizing data related to the individual; especially significant to counselors. *Preq:* ED F 808 or consent of instructor.

ED C 814 Development of Counseling Skills 3(3,0) On-campus experience to help counselors develop communication skills through role-playing activities, audio and videotaping, interviewing, lecture, and discussion. *Preq or Coreq:* ED C 810.

ED C 815 Group Counseling 3(3,0) Experience as a member of a group to aid the student in understanding group dynamics and the role of a group member as a participant and facilitator; emphasis is on small group participation, communication skills, and self-understanding. *Preq:* Consent of instructor.

ED C 816 Introduction to Marriage and Family Counseling 3(3,0) Major models and techniques of marriage and family counseling; history, research, legal, ethical, and other professional issues; concepts related to family life cycle, healthy family functioning, divorce, ethnicity, problem conceptualization, and nontraditional structures. *Preq:* ED C 810 or 814 or consent of instructor.

ED C 818 Psychopathology for Counselors 3(3,0) Conceptual models employed in classifying and describing various mental disturbances as well as approaches used to alleviate these disturbances. *Preq:* ED C 810, enrollment as Counseling master's student, consent of instructor.

ED C 819 The American College Student 3(3,0) How college students change and develop and how college can enhance that development. *Preq:* ED L 855 or consent of instructor.

ED C 821 Counseling Psychodiagnosis 3(3,0) Comprehensive overview of the DSM-IV-TR; multiaxial assessment and diagnosis of mental disorders including coding and reporting procedures. *Preq:* ED C 810, 818, enrollment as Counseling master's student, or consent of instructor.

ED C 822 Addictions Counseling 3(3,0) Comprehensive overview of the phenomenon of chemical dependence and addiction; current methods of identification and intervention; awareness of how addictions affect individuals, families, schools, and communities. *Preq:* Consent of instructor.

ED C 823 Advanced Counseling Techniques and Strategies 3(3,0) Development of in-depth counseling skills; techniques for working with a wide variety of populations and/or problems. *Preq:* ED C 814, 815, completion of 30 hours in a master's program in Counseling, or certification as a school counselor.

ED C 830 Professional School Counseling Practicum 3(1,6) Supervised field experience in counseling and other services in a school setting. To be taken Pass/Fail only. *Preq:* ED C 807, 813, 814, 815, or consent of instructor.

ED C 834 Student Affairs Practicum 3(1,6) Supervised field experience in counseling and other student services in a postsecondary school setting. To be taken Pass/Fail only. *Preq:* ED C 803 804, or consent of instructor (100 clock hours).

ED C 836 Community Practicum 3(1,6) Supervised field experiences in counseling and other services in a community-agency setting. To be taken Pass/Fail only. *Preq:* ED C 805, 814, 815 (or concurrent enrollment), consent of instructor.

ED C 840 Independent Study in Counseling 1-3(1-3,0) Individualized, in-depth study of a particular topic not offered in other courses. Reading, research, and independent study are supervised by a faculty member. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

ED C 841 School Counseling Internship 3-6 Students apply previous knowledge in consulting, counseling, and coordinating services in a supervised field experience for the school student. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* EDC 830 or consent of instructor.

ED C 844 Student Affairs Internship 3-6 Application of previous knowledge to professional and postsecondary settings in a supervised field experience in counseling/student services. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* ED C 834, consent of instructor.

ED C 846 Community Counseling Internship 3-6 Students apply previous knowledge of counseling theory and techniques in a supervised field experience to professional mental health counseling settings. May be repeated for a maximum of six credits. *Preq:* ED C 805, 811, 821, 823 (or concurrent enrollment), 836, consent of instructor.

ED C 885 Selected Topics 1-3(1-3,0) Developing trends in counseling not covered in other courses. May be repeated, but only if different topics are covered.

ED C 915 Internship in Counseling Setting 3(1,6) Postmaster's supervised internship in counseling. Provides experience in counseling as well as coordination of services for a diverse client population. Students participate in direct services with clients in an approved agency. May be repeated for a maximum of six credits. *Preq:* Master's degree in Counseling or related field approved by program coordinator.

ED C 920 Counselor Supervision 3(3,0) Overview of conceptual and empirical literature on counselor supervision that includes models, approaches, techniques, relationship/process issues, legal concerns, and ethical considerations. Students develop supervision skills through readings, seminar discussions, and supervision of master's-level students. *Preq:* Master's degree in Counseling or related area or consent of instructor.

EDUCATIONAL FOUNDATIONS

ED F (AG ED, CTE) 680 Educational Applications of Microcomputers 3(2,2) Fundamentals of computer applications for teachers. Develops competence in general computer applications such as word processing and database management and addresses educational uses of the Internet and computer-assisted instruction, with emphasis on legal and ethical issues and the impact of computer technology upon society. *Preq:* Admission to graduate teacher education program.

ED F (AG ED, CTE) 682 Advanced Educational Applications of Microcomputers 3(2,2) Provides students with the knowledge and skills needed to apply microcomputer technology to the utilization and generation of educational software in accordance with sound educational principles. *Preq:* ED F (AG ED, CTE) 480.

ED F 690 Student Management and Discipline 3(3,0) Aids pre-service and in-service teacher development and refines knowledge, skills, and values important for managing students in school settings. Practical application of theory and research and legal and ethical considerations are emphasized. *Preq:* ED F 302 or PSYCH 201; ED F 334 and 335 or suitable alternative; minimum grade-point ratio of 2.0.

ED F 697 Instructional Media in the Classroom 3(3,0) Integrated approach to the use of audiovisual media stressing systematic planning, selection, utilization, and evaluation as well as production of materials and equipment operation. *Preq:* 2.0 minimum grade-point ratio.

ED F 701 Human Growth and Development 3(3,0) Theory and research in human development and its impact on the teaching/learning process. *Preq:* ED F 334, 335, 336, or equivalent; classroom teaching experience.

ED F 702 Advanced Educational Psychology 3(3,0) Educational applications of research and theory on objectives, motivation, class climate, class management, and learning theory. *Preq:* ED F 302 or equivalent; classroom teaching experience recommended.

- ED F 703 Early Adolescent Growth and Development 3(3,0)** Theory and research in early adolescent growth and development and the teaching/learning process for middle-grades youth. *Preq:* Graduate standing or consent of instructor.
- ED F 766 Integrating Service Learning into Curriculum 3(2,3)** Opportunities for certified teachers to build competence in service learning through personal participation in service and in reflection. Students develop a plan to integrate service learning activities into the curriculum of their school and/or district. Designed for 12–25 elementary, middle-school, high-school, and adult-education teachers. *Preq:* Teaching certification.
- ED F 778 Experimental and Nonexperimental Research Methods in Education I 3(3,0)** Types of educational research and uses; logical bases of quantitative and qualitative analysis techniques; basic research issues important in education; educational research design and procedures; introduction to measurement and evaluation; applications to special problems in classroom settings and program development; and evaluation in curriculum, administration, and educational support services. *Preq:* EX ST 301 or equivalent or consent of instructor; ED F 808 recommended.
- ED F (ED L) 800 Philosophy, Schooling, and Educational Policy 3(3,0)** See ED L 800.
- ED F 808 Educational Tests and Measurements 3(3,0)** Construction, use, and interpretation of subjective and standard tests; measurement applications.
- ED F 870 Schooling as a Cultural Process 3(3,0)** Critical analysis of the interdependence of schooling and culture.
- ED F 872 History of American Education 3(3,0)** Historical development of educational purpose and the social and cultural forces which shaped that development.
- ED F 875 Seminar in Human Growth and Development 3(3,0)** Selected topics in human development from any area of the lifespan. Development topics are examined for their impacts on the teaching/learning process, administrative processes, and/or counseling approaches. *Preq:* ED F 701 or equivalent and teaching, counseling, or administrative experience.
- ED F 878 Experimental and Nonexperimental Research Methods in Education II 3(3,0)** Advanced concepts and skills needed to analyze, conduct, and evaluate educational research; nonexperimental, quasiexperimental, and experimental design specific to problems in educational research; complementary educational research methods involving qualitative approaches; coding and computer analysis of sample data; summarization and interpretation of data; applications of measurement and evaluation in educational research. *Preq:* ED F 778, 808, EX ST 801, or equivalent.
- ED F 879 Qualitative Research in Education 3(3,0)** Application of qualitative studies to educational questions; nature of qualitative research; rationale and applications of qualitative research methods; integration of qualitative and quantitative research methods in educational research. *Preq:* ED F 778, 878, or equivalent.
- ED F 880 Instructional Technology in the Elementary and Middle School 3(2,2)** Research-based strategies for integrating instructional technology within the curriculum; methodologies for deploying technology in support of national standards through participation in and development of project-based learning activities. *Preq:* Consent of instructor.
- ED F (ED, ED SP) 894 Directed Research 1-4(1-4,0)** See ED 894.
- ED F 908 Advanced Educational Tests and Measurement 3(3,0)** Theoretical and quantitative aspects of modern and classical test theory from the practitioner's perspective; solving contemporary problems involving intra-student and class level comparisons of student progress; the subsequent impact of assessment on classroom high-stakes accountability decisions. *Preq:* ED F 808 or equivalent; ED F 778 or equivalent.
- ED F 978 Multivariate Educational Research 3(3,0)** Investigates descriptive and inferential statistical methods for the exploratory analysis of outcomes in multigroup educational settings in which individuals tend to differ on multiple independent and dependent variables. *Preq:* ED F 878 or consent of instructor.
- ED F 980 (ED, ED SP) Internship in Curriculum and Instruction 1-6(0,3-18)** See ED 980.
- ED F (ED, ED SP) 991 Doctoral Dissertation Research 1-18** See ED 991.

EDUCATIONAL LEADERSHIP

ED L 700 Public School Administration 3(3,0)

Theoretical bases of school administration; organizational principles, patterns, and practices in public schools; decision making; administration of programs and services. *Preq:* Three graduate education courses or consent of instructor.

ED L 705 The Principals 3(3,0) Roles and responsibilities of the principalship including the organization and administration of schools.

ED L 710 Organizational Theory for School Administrators 3(3,0) Theory of management, communication, human relations, social systems, motivation, contingency, decision making, and change. *Preq:* ED L 700.

ED L 715 School and Community Relationships 3(3,0) Interdependence of school and community; identifying and defining societal expectations of schools and effect of these expectations on educational policy; impact of social, political, economic, and demographic change on educational policy.

ED L 720 School Personnel Administration 3(3,0) School personnel selection, practices, and problems. *Preq:* ED L 700, 705.

ED L 725 Legal Phases of School Administration 3(3,0) Legal principles involved in school administration and in court actions. *Preq:* ED L 710.

ED L 730 Techniques of Supervision—the Public Schools 3(3,0) Improving, coordinating, and evaluating instruction; modern trends of supervisory practices. *Preq:* ED L 710.

ED L 735 Educational Evaluation 3(3,0) Evaluation theory and design applied to classroom instruction and to evaluation procedures applicable to school center and district programs and projects. *Preq:* ED L 710.

ED L 740 Curriculum Planning and Improvement for School Administrators 3(3,0) Role of leadership in curriculum planning and improvement: curriculum evaluation and development, change, programmatic requirements, cocurriculum, organization, scheduling, planning, management, and technology. *Preq:* ED L 710.

ED L 745 School Finance 3(3,0) School finance relative to programs, revenues, and experience. *Preq:* ED L 735.

ED L 750 Elementary Principal and Supervisor Field Experience I 3(1,4) First practicum in a series of two with an experienced elementary/middle (pre-K–8) school principal or supervisor. ED L 750 and 751 must be taken in a sequence in a single academic year. *Preq:* ED L 705.

ED L 751 Elementary Principal and Supervisor Field Experience II 3(1,4) Second practicum in a series of two with an experienced elementary/middle (pre-K–8) school principal or supervisor. ED L 750 and 751 must be taken in a sequence in a single academic year. *Preq:* ED L 750.

ED L 755 Secondary Principal and Supervisor Field Experience I 3(1,4) First practicum in a series of two with an experienced secondary (grades 7–12) principal or supervisor. ED L 755 and 756 must be taken in a sequence in a single academic year. *Preq:* ED L 705.

ED L 756 Secondary Principal and Supervisor Field Experience II 3(1,4) Second practicum in a series of two with an experienced middle/high school (grades 7–12) principal or supervisor. ED L 755 and 756 must be taken in a sequence in a single academic year. *Preq:* ED L 755.

ED L 765 Assessment in Higher Education 3(3,0) Outcomes assessment and institutional effectiveness movement including assessment techniques, instrument selection, analysis of assessment data, and reporting of assessment findings. *Preq:* Consent of instructor.

ED L 795 School Leadership Information Systems 3(2,2) Use of computers and related technologies for decision making by public school leaders; logistics of information management, sources of information, communication with technology, and integration of technology into the leadership function.

ED L (ED F) 800 Philosophy, Schooling, and Educational Policy 3(3,0) Development of contemporary educational theory and its impact on current schooling practices and educational policy development.

ED L 805 Advanced Educational Leadership: Theory and Practice 3(3,0) Principles and theories of leadership as practiced in the institutional setting. *Preq:* ED L 715, 730.

ED L 810 Introduction to School Building Planning 3(2,2) Planning of educational facilities from conception of need through utilization of facility. *Preq:* ED L 700.

ED L 815 The Superintendency 3(3,0) Current, in-depth study of the superintendency including relationships with school boards, faculty, staff, and community. For practicing and aspiring educational administrators. *Preq:* Admission to the Educational Specialist program or the doctoral program.

- ED L 820 Politics of Education 3(3,0)** Politics of education in the United States including complex interrelationships among administrators, special interest groups, politicians, and knowledge brokers.
- ED L 830 Business Management in Education 3(2,3)** Fiscal management of individual schools and districts including budgeting, purchasing, and accounting for funds. *Preq:* ED L 725, 745.
- ED L 839 Research Methods in Educational Leadership 3(3,0)** Development of design, method, and procedures for conducting the educational specialist project. Course culminates in the completion and presentation of the project prospectus for approval by the instructor and the student's major advisor. *Preq:* ED L (ED F) 800, 805, 820, consent of instructor.
- ED L 840 Field Problems in School Administration and Supervision of Instruction 3(2,3)** Application of research techniques and practices in solution of field problems in school administration and supervision. *Preq:* ED F 778, ED L 700.
- ED L 850 Practicum in School System Leadership I 3** First in a two-semester practicum with an experienced school-system-level administrator or supervisor. *Preq:* ED L (ED F) 800, 805, 815, or consent of instructor.
- ED L 851 Practicum in School System Leadership II 3** Second in a two-semester practicum with an experienced school-system-level administrator or supervisor. *Preq:* ED L 850.
- ED L 855 Applied Research and Evaluation in Higher Education 3(3,0)** Basic issues of measurement emphasizing questionnaire development, scales, and measures commonly used in higher education research, assessment, and program evaluation.
- ED L 885 Selected Topics in Educational Administration 1-3(1-3,0)** Current literature and results of current research. Topics vary from year to year. May be repeated for a maximum of six credits.
- ED L 900 Principles of Educational Leadership 3(3,0)** Advanced leadership theory; the nature of leadership, major theories of leadership, and their application in educational organizations. *Preq:* Admission to PhD program in Educational Leadership.
- ED L 905 Theory and Practice in Educational Leadership 3(3,0)** Advanced organizational and leadership theory; major theories of organization and their applications in understanding the roles of governmental agencies in society. *Preq:* Admission to the doctoral program.
- ED L 910 Introductory Doctoral Seminar 3(3,0)** Educational leadership for beginning doctoral students providing an introduction to the conceptual and theoretical frameworks of educational leadership for both public school and higher education administration. *Preq:* Consent of instructor.
- ED L 915 Educational Planning 3(3,0)** Systems approach to planning and management; the measurement and interpretation of performance results.
- ED L 925 Instructional Leadership 3(3,0)** Preparation for a career in educational leadership; the principal's functions in the effective school's movement as incorporated in instructional leadership.
- ED L 935 History of Higher Education 3(3,0)** Development of higher education from the 11th century to the present with emphasis on the United States.
- ED L 950 Educational Policy Studies 3(3,0)** Critical analysis of the sources and nature of educational policy and how policy is developed, administered, and assessed for public schools. *Preq:* Admission to doctoral studies.
- ED L (VT ED) 955 The Two-Year College 3(3,0)** Historical developments, functions, organization, and administration of the two-year college. *Preq:* Admission to doctoral studies or consent of instructor.
- ED L 960 Legal Principles in the Administration of Institutions of Higher Education 3(3,0)** General principles of higher education law from the points of view of statute and common law practice. *Preq:* Admission to doctoral studies or consent of instructor.
- ED L 962 Governance in Higher Education 3(3,0)** Exposes students to literature on the organization and governance of higher education institutions. Helps future leaders of higher education understand the distinctive organizational and behavioral features of post-secondary institutions and gives them the knowledge base to make better decisions for their institutions. *Preq:* Admission to doctoral studies and consent of instructor.
- ED L 965 Higher Education Finance 3(3,0)** Higher education finance relative to sources of revenue, expenditures, and planning.
- ED L 970 Foundations of Higher Education 3(3,0)** Survey of American higher education including its historical, political, philosophical, and social aspects. *Preq:* Admission to doctoral studies.
- ED L 972 Ethics in Educational Leadership 3(3,0)** The ethical issues involved in administering educational institutions; moral leadership, ethical work environments, and decision-making models.
- ED L 975 College Teaching 3(3,0)** Comprehensive preparation for teaching at the college level: course design and development around student outcomes/objectives; teaching strategies that motivate today's diverse students and promote active, multimodal, collaborative, and experiential learning; assessment of student learning and teaching effectiveness; institutional issues; and job search preparation. *Preq:* Consent of instructor.
- ED L 976 External Effectiveness in Higher Education 3(3,0)** Optimum structures and strategies for fund raising, public relations, constituent relations, governmental affairs, and governing boards necessary for a college or university to communicate effectively with its constituents.
- ED L 980 Current Issues in Educational Leadership 1-3(1-3,0)** Topics and issues as determined by the needs of the students and the instructor. *Preq:* Graduate standing, consent of instructor.
- ED L 985 Internship in Educational Leadership I 3** First in a two-semester internship to provide experience in leadership role under the guidance of an experienced field mentor at the student's chosen level of specialization in educational leadership (public schools or institutions of higher education). *Preq:* ED L 900, 905, 910, or consent of advisor.
- ED L 986 Internship in Educational Leadership II 3** Second in a two-semester internship to provide experience in leadership role under the guidance of an experienced field mentor at the student's chosen level of specialization in educational leadership (public schools or institutions of higher education). *Preq:* ED L 985.
- ED L 988 Directed Research 3(3,0)** First in a sequence of three required post-candidacy courses in which students refine the conceptual basis for their research questions in directed study with faculty. To be taken Pass/Fail only. *Preq:* Admission to doctoral candidacy or consent of instructor.
- ED L 989 Advanced Doctoral Seminar I 3(3,0)** Explores educational leadership topics. Culminates in the selection of a topic for presentation and approval and the development of Chapter I of a prospectus. To be taken Pass/Fail only. *Preq:* ED L 900, 905, 910, consent of instructor.
- ED L 990 Advanced Doctoral Seminar II 3(3,0)** Seminar for advanced students focusing on the preparation of dissertation Chapters I–III.
- ED L 991 Doctoral Dissertation Research 1-18**

ELECTRICAL AND COMPUTER ENGINEERING

- E C E 604 Semiconductor Devices 3(3,0)** Consideration of the principles of operation, external characteristics, and applications of some of the more important semiconductor devices available. *Preq:* E C E 320. *Coreq:* MTHSC 311 or 434.
- E C E 606 Introduction to Microelectronics Processing 3(3,0)** Microelectronic processing, MOS and bipolar monolithic circuit fabrication, thick and thin film hybrid fabrication, applications to linear and digital circuits, fundamentals of device design. *Preq:* E C E 320. *Coreq:* MTHSC 311 or 434.
- E C E 610 Modern Control Theory 3(3,0)** Introduction to modern control theory including fundamentals of matrix algebra, state space analysis and design, nonlinear systems, and optimal control. *Preq:* E C E 409.
- E C E 617 Elements of Software Engineering 3(3,0)** Foundations of software design, reasoning about software, the calculus of programs, survey of formal specification techniques, and design languages. *Preq:* E C E 329, MTHSC 419.
- E C E 618 Power System Analysis 3(3,0)** Study of power system planning and operational problems. Subjects covered include load flow, economic dispatch, fault studies, transient stability, and control of problems. System modeling and computer solutions are emphasized through class projects. *Preq:* E C E 360, 380.
- E C E 619 Electric Machines and Drives 3(3,0)** Performance, characteristics, and modeling of AC and DC machines during steady-state and transient conditions. Introduction to power electronics devices and their use in adjustable speed motor drives. *Preq:* E C E 321, 360, 380. *Coreq:* MTHSC 434 or consent of instructor.

- E C E 622 Electronic System Design I 3(2,2)** Emphasizes the application of theory and skills to the design, building, and testing of an electronic system with both analog and digital components. Application varies each semester. Extensive use is made of computer software tools in the design process. *Preq:* E C E 321, 330, 360, 371, 381.
- E C E 629 Organization of Computers 3(3,0)** Computer organization and architecture. Topics include a review of logic circuits, bus structures, memory organization, interrupt structures, arithmetic units, input-output structures, state generation, central processor organization, control function implementation, and data communication. Registered Transfer Language (RTL) for description and design of digital systems. *Preq:* E C E 272 or consent of instructor.
- E C E 630 Digital Communications 3(3,0)** Introduction to modern digital communication systems emphasizing modulation and detection, taking into account the effects of noise. *Preq:* E C E 317, 330.
- E C E 631 Digital Electronics 3(2,2)** Electronic devices and circuits of importance to digital computer operation and to other areas of electrical engineering are considered. Active and passive waveshaping, waveform generation, memory elements, switching, and logic circuits are some topics. Experimentation with various types of circuits is provided by laboratory projects. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.
- E C E 632 Instrumentation 3(3,0)** Theory and analysis of transducers and related circuits and instrumentation. Generalized configurations and performance characteristics of instruments are considered. Transducer devices for measuring physical parameters such as motion, force, torque, pressure, flow, and temperature are discussed. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.
- E C E 636 Microwave Circuits 3(3,0)** Analysis of microwave networks comprising transmission lines, waveguides, passive elements, interconnects, and active solid state microwave circuits. Use of modern CAD tools to design RF/Microwave passive/active networks. Fabrication of typical circuits. *Preq:* E C E 381 or equivalent. *Coreq:* MTHSC 311 or 434.
- E C E 638 Computer Communications 3(3,0)** Digital data transmission techniques, modems and communications channels, communications software and protocols, multiprocessors, and distributed processing; concurrency and cooperation of dispersed processors. *Preq:* Senior standing in Electrical or Computer Engineering or Computer Science or consent of instructor.
- E C E 639 Fiber Optics 3(3,0)** Underlying principles of design for optical fibers in practical systems are covered. Optical fiber as a waveguide is examined using wave optics and ray optics. Design criteria for using mono- and multi-mode fibers are discussed. Other topics include fabrication and measurement. *Preq:* E C E 381. *Coreq:* MTHSC 434 or consent of instructor.
- E C E 640 Performance Analysis of Local Computer Networks 3(3,0)** Introduction to design and performance analysis of local computer networks. Emphasis is on performance analysis of representative multi-access procedures. Three common types of networks are considered in detail. *Preq:* E C E 272, 317.
- E C E 642 Knowledge Engineering 3(3,0)** Introduction to theoretical and practical aspects of knowledge engineering or applied artificial intelligence. Topics include symbolic representation structures and manipulation, unification, production systems and structures, rule-based and expert systems, planning and AI system architectures; system design in PROLOG and LISP. Project is required. *Preq:* E C E 329, 352.
- E C E 646 Antennas and Propagation 3(3,0)** Study of the theoretical and practical aspects of antenna design and utilization, input impedances, structural considerations, and wave propagation. *Preq:* E C E 330, 381 or 436; MTHSC 311 or 434.
- E C E 649 Computer Network Security 3(1,4)** Hands-on practicum in the administration and security of modern network service with an emphasis on intrusion prevention techniques, detection, and recovery. *Preq:* Graduate standing in a technical field.
- E C E 655 Robot Manipulators 3(3,0)** Analysis of robot manipulator systems with special focus on interaction of these technologies with society. Emphasis is on rigid-link robot manipulator systems. Topics include history of robot technology, kinematics, dynamics, control, and operator interfaces. Case studies reinforce impact of robot technology on society and vice versa. *Preq:* MTHSC 206, 311, or consent of instructor.
- E C E (M E) 656 Fundamentals of Robotics 3(3,0)** See M E 656.
- E C E 659 Integrated Circuit Design 3(2,2)** Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries, custom and semicustom integrated circuits; computer-aided design software/hardware trends and future developments; hands-on use of CAD tools to design standard library cells; systems design considerations, testing, and packaging. *Preq:* E C E 321. *Coreq:* MTHSC 311 or 434.
- E C E 667 Introduction to Digital Signal Processing 3(3,0)** Introduction to characteristics, design, and applications of discrete time systems; design of digital filters; Fast Fourier Transform (FFT); LSI hardware for signal processing applications. *Preq:* E C E 330.
- E C E 668 Embedded Computing 3(2,2)** Principles of using computing in the larger context of a system. Topics include bus and processor design types (e.g. microprocessor, microcontroller, DSP), co-decs, digital circuit power management, real time scheduling, and embedded operating systems. Lab work consists of projects on embedded hardware (e.g. PC-104+). *Preq:* E C E 371, CP SC 212; or consent of instructor.
- E C E 692 Special Problems 1-3** Special assignment in electrical or computer engineering. Typical assignments include computer programs, term papers, technical literature searches, hardware projects, and design project leadership. May be taken only once for credit.
- E C E 693 Selected Topics 1-3(1-3,0)** Classroom study of current and new technical developments in electrical and computer engineering. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.
- E C E 701 Master of Engineering Design Project 1-6** Practical problems in engineering analysis and design culminating in the written report required for the MEng degree. To be taken Pass/Fail only. May be repeated for a maximum of six credits.
- E C E 801 Analysis of Linear Systems 3(3,0)** Foundations of linear system analysis; matrix algebra, linear graph theory, and operational mathematics applied to formulation and solution of system equations in time and frequency domains.
- E C E 802 Electric Motor Control 3(3,0)** Dynamic modeling and analysis of electrical machines for design of AC and DC drive systems; implementation of such models on a digital computer; voltage-fed inverters; pulse width modulation and analysis techniques for inverters; harmonic generation and reduction. *Preq:* E C E 434.
- E C E 804 Methods of Applied Optimization and Optimum Control 3(3,0)** Methods of optimizing systems with and without dynamics including linear programming, nonlinear programming, integer programming, gradient and variational calculus, minimum principle, principle of optimality, and dynamic programming. *Coreq:* MTHSC 653.
- E C E 805 Methods of State and Parameter Estimation of Stochastic Systems 3(3,0)** State and parameter estimations of both linear and nonlinear continuous-time and discrete-time systems including model identification: Kalman and Wiener filters, fixed-interval, fixed-point and fixed-lag smoothers, stochastic approximation estimation, nonlinear estimation by statistical linearization, and sensitivity analysis of Kalman filters. *Coreq:* MTHSC 654.
- E C E 807 Computer Methods for Power Systems Analysis 3(3,0)** Electric power system operation; development of models of transmission line components and networks; computer methods for solving linear and nonlinear systems of network equations; operating problems in load flow, scheduling and economic dispatch. *Preq:* E C E 418.
- E C E 811 Integrated Circuit Design 3(2,2)** Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries; custom and semicustom integrated circuits; computer-aided design software/hardware trends and future developments; the hands-on use of CAD tools to design MOS standard cells; systems design, testing, and packaging. *Preq:* E C E 459.

- E C E 816 Electric Power Distribution System Engineering 3(3,0)** Radial circuit analysis techniques, feeder and transformer modeling, load modeling, loss minimalization and voltage control, causes of power quality problems, motor starting analysis, strategies for analyzing impacts of disturbances. *Preq:* E C E 418, 419, or consent of instructor.
- E C E 817 Power System Transients 3(3,0)** Electrical transients in power systems; frequency domain and time domain techniques for power systems transient analysis; capacitor switching, load switching, fault-induced transients, line reclosing, and single pole switching. *Preq:* Consent of instructor.
- E C E 818 Random Process Applications in Engineering 3(3,0)** Theory of random processes emphasizing engineering applications; stochastic convergence and limit theorems; martingales; mean-square calculus; Karhunen-Loeve expansions; systems with stochastic inputs; Poisson processes; shot noise; Weiner processes; white noise processes; Markov systems; queuing systems; and estimate theory. *Preq:* E C E 317 and 330 or consent of instructor.
- E C E 819 Detection and Estimation Theory 3(3,0)** Theory of statistical testing of hypotheses applied to detection and estimation of communication signal parameters; detection of signals with random amplitude, phase, and arrival time in noise; detection of single and multiple observation; estimates and their properties; signal resolution. *Preq:* E C E 820.
- E C E 820 Digital Communication Systems I 3(3,0)** Modern communications systems emphasizing modulation and methods of taking into account effects of noise on various systems. *Preq:* E C E 428 or equivalent.
- E C E 821 Digital Communication Systems II 3(3,0)** Continuation of E C E 820.
- E C E 822 Information Theory 3(3,0)** Statistical problems encountered in information handling; relations of probability, information, and coding theory; unified treatment of set theory, sample space, random variables, information measure, and capacity applied to communication.
- E C E 823 Integrated Circuit Technology 3(3,0)** Physical and chemical principles underlying the major processing operations used in the fabrication of integrated circuit semiconductor devices, process simulation, diagnostic testing, and factors affecting device yield and reliability. *Preq:* Consent of instructor.
- E C E 824 Power System Protection 3(3,0)** Coordination of power system protection components including microprocessor based relay-adaptive protection of power system, power system disturbance identification and system restoration following a major disturbance. *Preq:* E C E 418 or consent of instructor. *Coreq:* MTHSC 434 or consent of instructor.
- E C E 825 Solid-State Electronics 3(3,0)** Modern physics approach to electrons in solids; elementary quantum mechanics; statistics; plasmas; band theory; application of these principles to modern amplifiers; e.g., the traveling-wave tube, tunnel diode, masers, and parametric amplifiers.
- E C E 827 Finite Difference Methods in Electromagnetics 3(3,0)** Investigates finite-difference methods (FD) as applied to electromagnetics; FD approximations, error, stability, and numerical dispersion; solution of Poisson's, Helmholtz, and wave equations; banded matrices, iterative methods, and eigensolutions; the finite-difference time-domain method, Yee Lattice, mesh truncation methods, perfectly matched layers, source conditions, near-to-far field transformation, subcellular modeling for fine features, and wide-band characterization. *Preq:* E C E 436 or 446 or equivalent. *Coreq:* E C E 830.
- E C E 828 Guided Waves, Wave Propagation, and Radiation in Stratified Media 3(3,0)** Covers several important topics of applied electromagnetics, including advanced transmission-line theory for guided electromagnetic waves, analysis of electromagnetic wave propagation in layered media, and computation of electromagnetic radiation in stratified regions. *Preq:* E C E 829, 830.
- E C E 829 Special Functions in Engineering 3(3,0)** Complex calculus and analytic functions; origin of special functions in engineering; series and integral representations of special functions; properties and applications of gamma, Bessel, Legendre, Chebyshev, etc. functions; computation of special functions; applications in selected engineering problems. *Preq:* Consent of instructor.
- E C E 830 Electromagnetics 3(3,0)** Wave equations and waves, electromagnetic potentials, theorems and advanced concepts, guided waves, radiation, boundary value problems, and simple Green's functions. *Preq:* E C E 380, 381; or equivalent.
- E C E 831 Advanced Electromagnetic Theory 3(3,0)** Advanced boundary-value problems in cylindrical and spherical coordinates, special functions, Sommerfeld integrals, Green's functions, and integral equations. *Preq:* E C E 830.
- E C E 834 Asymptotic Methods and Diffraction Theory 3(3,0)** Canonical diffraction problems for which exact solutions are available; asymptotic reevaluation of these solutions in terms of incident, reflected and diffracted rays leads to Keller's postulates for an extended theory or geometrical theory of diffraction; application of diffraction from edges and curved surfaces to scattering and antenna problems. *Preq:* E C E 830.
- E C E 835 Finite Element Methods in Electromagnetics 3(3,0)** Finite-element methods (FEM) as applied to electromagnetics; fundamentals of list-linked FEM data structures, sparse matrix solutions, edge-based vector bases, radiation boundary conditions, and perfectly absorbing media. *Coreq:* E C E 830.
- E C E 836 Microwave Circuits and Systems 3(3,0)** Application of the mathematics and physical principles of electromagnetic field theory and electrical circuit analysis to the geometries that are of interest in modern microwave engineering; transmission lines, waveguides, discontinuities, interconnection of multiports, and periodic structures. *Preq:* E C E 436. *Coreq:* E C E 830.
- E C E 837 Advanced Antenna Theory 3(3,0)** The antenna as a radiating and receiving device; examination by classical and numerical techniques of the relations between structure and performance, gain and terminal conditions. *Preq:* E C E 446. *Coreq:* E C E 830.
- E C E 838 Special Topics in Electromagnetics 1(1,0)** Methods of solving selected electromagnetic problems with emphasis on Green's functions, equivalence principle, dynamic potential theory, and boundary value techniques. May be repeated for credit. *Preq:* Consent of instructor.
- E C E 839 Integral Equations in Electromagnetics 3(3,0)** Integral equation formulation in electromagnetics, solution techniques, moment methods, and application to practical problems. *Preq:* E C E 830 or consent of instructor.
- E C E 840 Physics of Semiconductor Devices 3(3,0)** Semiconductor device physics emphasized rather than circuits; detailed analysis of the p-n junction, traps, surface states and conduction processes, and devices; analysis and models of Schottky diode, MIS diode, MOSFET, charge couples devices, and solar cells; charge control concepts, transit time effects, surface-type devices and practical aspects of device process. *Preq:* E C E 404, 406.
- E C E 842 Computer Architecture 3(3,0)** Fundamental issues that arise in the composition of logic elements into computer systems; design and analysis of processors, busses, memory hierarchies, communications controllers, and associated software. *Preq:* E C E 429 or equivalent.
- E C E 844 Digital Signal Processing 3(3,0)** Digital filter design; discrete Hilbert transforms; discrete random signals; effects of finite register length in digital signal processing; homomorphic signal processing; power spectrum estimation; speech processing, radar, and other applications. *Preq:* E C E 467.
- E C E 845 Computer System Design and Operation 3(3,0)** Factors involved in design, acquisition, and operation of a computer system; analysis methods; alternative computer systems; computer economics; performance evaluation; operational requirements. *Preq:* Consent of instructor.
- E C E 846 Digital Processing of Speech Signals 3(3,0)** Application of digital signal processing techniques to problems related to speech synthesis, recognition, and communication; digital models and representations of speech wave forms; Fourier analysis; homomorphic processing; linear predictive coding; algorithms for recognizing isolated words and continuous speech; man-machine communications by voice. *Preq:* E C E 467.
- E C E 847 Digital Image Processing 3(3,0)** Review of fundamental concepts, issues, and algorithms in image processing. Includes image formation, file formats, filters, edge detection, stereo, motion, and color. *Preq:* E C E 467.
- E C E 848 Telecommunication Network Modeling and Analysis 3(3,0)** Protocols, modeling, and analysis of telecommunication networks with emphasis on quantitative performance modeling of networks and systems using packet switching and circuit switching techniques. *Preq:* CP SC 825 or E C E 438.

- E C E 849 Advanced Topics in Computer Communications 3(3,0)** Performance analysis and design of computer communication networks with emphasis on recent developments; routing flow control, error control, and end-to-end performance analysis, local area, packet radio, and long haul store-and-forward networks. *Preq:* E C E 438 or 440, consent of instructor.
- E C E 850 Computation and Simulation 3(3,0)** Computer modeling as related to engineering problems; matching problems and computers to obtain most effective solution.
- E C E 851 Advanced Topics in Computer Architecture 3(3,1)** Analysis and design of multiprocessor and modular computer systems; recent developments in integration, fabrication, and application of multiprocessor systems. *Preq:* E C E 842.
- E C E 852 Software Engineering 3(3,0)** Design, construction verification, and testing of large-scale computer software systems; software science, requirements writing, design graphics, the calculus of programs, verification proofs, and symbolic execution. *Preq:* Computer Engineering major or consent of instructor.
- E C E 854 Analysis of Robotic Systems 3(3,0)** Methods of designing and operating robotics systems for advanced automation; on-line identification and description of 3-D objects by digitized images; off-line collision-free path planning and on-line collision avoidance traveling using artificial intelligence. *Preq:* M E (E C E) 456 or consent of instructor.
- E C E 855 Artificial Intelligence 3(3,0)** Emulating intelligent behavior by computer; models of cognitive processes; logical foundations; constraint satisfaction problems; natural language understanding; pattern-directed inference and chaining paradigms; goal-directed behavior, planning, and search; learning; advanced database structure and inference strategies; examples of LISP, PROLOG, and OPS5. *Preq:* E C E 442.
- E C E 856 Pattern Recognition 3(3,0)** Several approaches to general pattern recognition problems with practical computer-oriented applications; feature extraction; classification algorithms; discriminant functions; learning schemes; statistical methods; information theoretic approaches; applications; current developments.
- E C E 857 Coding Theory 3(3,0)** Principles of algebraic coding and its application to transmission of information over noisy communications channels; introduction to abstract algebra; code performance bounds; code representations; linear codes of the Hamming and Bose-Chandhuri types and burst-error correcting codes; problems of implementation and decoding. *Preq:* E C E 317 or equivalent.
- E C E (M E) 859 Intelligent Robotic Systems 3(3,0)** Integration and fusion of data from multiple sensors on multiple robots; intelligent decision making on motion planning and execution based on sensed data involving mutual compliance; simultaneous force and position controls using computers. *Preq:* E C E (M E) 854.
- E C E 860 Advanced Coding Theory 3(3,0)** Introduction to convolutional codes and trellis-coded modulation. Topics include code generation and representation, distance properties, decoding techniques, performance analysis, multidimensional codes and lattice theory, and coding for fading channels; applications to wireline communications and mobile communications. *Preq:* E C E 828, 857.
- E C E 862 Real Time Computer Application in Power Systems 3(3,0)** Principles of monitoring, control, and operation of power systems; load frequency control, on-line load flow, power system state estimation, unit commitment, and load forecasting. *Preq:* E C E 418.
- E C E 863 Power System Dynamics and Stability 3(3,0)** Modeling of synchronous machines and their control systems; power system stability for small and large disturbances; excitation systems, governor control, power system stabilizers, and state variables formulation for power systems dynamic stability studies. *Preq:* E C E 418, 419.
- E C E 869 Advanced Kinematics in Robotics 3(3,0)** Complex robotic systems, such as multi-fingered robot hands, dual-armed robots and multi-joint "snakelike" robots; kinematic redundancy, load distribution, and dexterous manipulation; effective modeling and solution techniques for these types of underconstrained systems. *Preq:* E C E 409, M E (E C E) 656, or consent of instructor.
- E C E 872 Artificial Neural Networks 3(3,0)** Design, analysis, and application of artificial neural networks, neuron models, network architectures, training (supervised and unsupervised), and hardware implementation; extended studies of selected applications and simulation exercises. *Preq:* MTHSC 311 or consent of instructor, graduate standing.
- E C E 873 Parallel and Distributed Systems 3(3,0)** Design, analysis, and evaluation of algorithms for parallel and distributed computer systems; time complexity, speedup, efficiency, and isoeficiency; communication costs; numerical algorithms including solving systems of equations (both sparse and dense) as well as symbolic algorithms; substantial parallel programming projects.
- E C E 874 Advanced Nonlinear Control 3(3,0)** Basics of nonlinear control based on Lyapunov techniques; adaptive control design, robust control design, and observer design; understanding and development of Lyapunov control design tools. *Preq:* E C E 801 or equivalent.
- E C E 877 Computer Vision 3(3,0)** Investigation into fundamental concepts, issues, and algorithms in computer vision. Includes segmentation, texture, detection, 3-D reconstruction, camera calibration, shape, and energy minimization. *Preq:* E C E 847
- E C E 890 Engineering Report Research 1-3** Research culminating in writing an engineering report to satisfy one of the requirements for the nonthesis option for the MS degree. To be taken Pass/Fail only.
- E C E 891 Master's Thesis Research 1-12**
- E C E 892 Special Problems in Electrical and Computer Engineering 1-3(1-3,0)** Term paper, special design, or other problems in electrical and computer engineering approved by the instructor. May not be used for investigation associated with the MS thesis or the engineering report. May be repeated for credit.
- E C E 893 Selected Topics in Electrical and Computer Engineering 1-3(1-3,0)** Topics not covered in other courses; current literature and results of current research. Topics vary from year to year in keeping with developments in the field. May be repeated for credit. *Preq:* Consent of instructor.
- E C E 903 Computer Architecture Seminar 1(1,0)** Recent research publications related to computer architecture including parallel systems, distributed computing, reconfigurable architectures, and software development for high performance computing. Students read and discuss one research paper weekly and present one research paper each semester. May be repeated for a maximum of three credits. *Preq:* Consent of instructor.
- E C E 904 Computer Vision Seminar 1(1,0)** Review of recent research publications related to computer vision including tracking, correspondence, reconstruction, and segmentation. Students read and discuss one research paper per week and present one research paper each semester. May be repeated for a maximum of three credits.
- E C E 905 Computer Security Seminar 1(1,0)** Review of current research publications related to computer and network security including software assurance, biometrics, applied cryptography, and other security relevant topics. Students read and discuss one research paper weekly and present one or more research papers each semester. May be repeated for a maximum of three credits. *Preq:* Consent of instructor.
- E C E 991 Doctoral Dissertation Research 1-12**

ELEMENTARY EDUCATION

- ED EL 760 Curriculum Development in the Elementary School 3(3,0)** Analysis of trends and practices relative to elementary curriculum planning. Designed to develop an understanding of the essential elements of curriculum decisions followed by the process of improving the curriculum. *Preq:* ED F 701, 702, or consent of instructor.
- ED EL 804 Advanced Methods of Teaching in the Elementary School 3(3,0)** Principles and practices involved in promoting effective learning in elementary schools; analysis and evaluation of educational models and research. *Preq:* ED EL 760 or consent of instructor.
- ED EL 826 Elementary School Science: Theory to Practice 3(3,0)** In-depth study of current research and trends in science theory, teaching strategies, and curriculum development from birth to grade six. *Preq:* Admission to MEd program in Early Childhood or Elementary Education or consent of instructor.

ED EL 831 Advanced Methods in Elementary School Social Studies Education 3(3,0) Techniques, resources/materials, theories, and research for teaching social studies in the elementary/middle school classroom; current research trends in social studies education, national, and state standards, addressing the needs of a diverse student population, fostering a classroom community, and developing an integrated approach to social studies education. *Preq:* Admission to the MEd program or consent of instructor.

ED EL 890 Education Research Project 3(2,3) Students select, with approval of professor, and conduct research on an education issue of suitable scope. Oral, written, and visual presentation of the research project is required. Students must enroll during final semester. *Preq:* Consent of instructor.

ED EL 892 Elementary School Mathematics: Theory to Practice 3(3,0) In-depth study of current research and trends in mathematics theory, teaching methods, and curriculum development from birth to grade six. *Preq:* Admission to MEd program in Early Childhood or Elementary Education or consent of instructor.

ED EL 937 Designing Elementary Curriculum 3(3,0) Theoretical issues and guidelines for educators engaged in the curriculum development process at the elementary level. *Preq:* Admission to the PhD program in Curriculum and Instruction, ED 954, 955, 956.

ED EL 938 Teacher as Researcher 3(3,0) Various methodologies of field-based research. Students complete a literature review and design a field-based research project. *Preq:* Admission to the PhD program in Curriculum and Instruction, ED 878, 879, EX ST 801, one of the following: EDSEC 846, 847, 848, 849, READ 944.

ENGINEERING GRAPHICS

E G 612 Interactive Computer Graphics 3(3,0) Graphics hardware and display technology; reduction and presentation of engineering data; techniques of geometrical transformations, perspective, and model manipulation; methodology of computer-aided design; application of higher-level software to engineering problems. *Preq:* E G 208 and MTHSC 208 or consent of instructor.

E G 690 Special Topics in Engineering and Computer Graphics 1-3(1-3,0) Comprehensive study of any computer-aided topic in engineering graphics not covered in other courses. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

ENGLISH

ENGL 600 The English Language 3(3,0) Studies in English usage and historical development of the language. *Preq:* ENGL 310 or consent of instructor.

ENGL 601 Grammar Survey 3(3,0) Survey of modern grammars, focusing on the impact of structural grammar on traditional grammar. Recommended for English teachers. *Preq:* ENGL 310 or consent of instructor.

ENGL 607 The Medieval Period 3(3,0) Selected works of Old and Middle English literature, excluding Chaucer. *Preq:* ENGL 310 or consent of instructor.

ENGL 608 Chaucer 3(3,0) Selected readings in Middle English from *The Canterbury Tales* and other works by Chaucer. *Preq:* ENGL 310 or consent of instructor.

ENGL 610 Drama of English Renaissance 3(3,0) Selected readings in non-Shakespearean dramatic literature of the 16th and 17th centuries. *Preq:* ENGL 310 or consent of instructor.

ENGL 611 Shakespeare 3(3,0) Study of selected tragedies, comedies, and history plays of Shakespeare. Required of all English majors. *Preq:* ENGL 310 or consent of instructor.

ENGL 614 Milton 3(3,0) Development of Milton's art and thought from the minor poems and selected prose through *Paradise Lost*, *Paradise Regained*, and *Samson Agonistes*, set against the background of the late Renaissance. *Preq:* ENGL 310 or consent of instructor.

ENGL 615 The Restoration and Eighteenth Century 3(3,0) Readings in Dryden, Swift, Pope, and Dr. Johnson. *Preq:* ENGL 310 or consent of instructor.

ENGL 616 The Romantic Period 3(3,0) Readings from the poetry and critical prose of Blake, Wordsworth, Coleridge, Byron, Shelley, Keats, and other representative figures. *Preq:* ENGL 310 or consent of instructor.

ENGL 617 The Victorian Period 3(3,0) Readings from the poetry and nonfiction prose of selected Victorian authors, including works of Carlyle, Tennyson, Browning, Arnold, and other representative figures. *Preq:* ENGL 310 or consent of instructor.

ENGL 618 The English Novel 3(3,0) Study of the English novel from its 18th century beginnings through the Victorian period. *Preq:* ENGL 310 or consent of instructor.

ENGL 619 Post-Colonial Studies 3(3,0) Selected readings in post-colonial literature and theory, focusing on issues of nationalism, migration, resistance, race, language, and master narratives. *Preq:* ENGL 310 or consent of instructor.

ENGL 625 The American Novel 3(3,0) Survey of the most significant forms and themes of the American novel from its beginnings to 1900. *Preq:* ENGL 310 or consent of instructor.

ENGL 626 Southern Literature 3(3,0) Intellectual and literary achievement of the South from 1607 to the present, with emphasis upon the writers of the 19th century. *Preq:* ENGL 310 or consent of instructor.

ENGL 627 Agrarianism and the Humanistic Tradition 3(3,0) Focuses on the importance of agriculture and rural life to the humanistic tradition of Western Civilization from antiquity through the early years of the American republic. *Preq:* ENGL 310 or consent of instructor.

ENGL 628 Contemporary Literature 3(3,0) Focuses on American, British, and other fiction, poetry, and drama from the Post-World War II to the present. *Preq:* ENGL 310 or consent of instructor.

ENGL 629 Dramatic Literature I 3(3,0) Selected reading in dramatic literature from the classical era of Greece and Rome to the Renaissance. *Preq:* ENGL 310 or consent of instructor.

ENGL (THEA) 630 Dramatic Literature II 3(3,0) Principles and progress of drama from the Restoration to the present; analysis of representative plays; critical reports; discussion of trends in dramatic literature. *Preq:* ENGL 310 or consent of instructor.

ENGL 631 Modern Poetry 3(3,0) The modern tradition in English and American poetry from Yeats to the present; relevant critical essays. *Preq:* ENGL 310 or consent of instructor.

ENGL 632 Modern Fiction 3(3,0) American and British novels and short stories of the 20th century. *Preq:* ENGL 310 or consent of instructor.

ENGL 633 The Anglo-Irish Literary Tradition 3(3,0) Exploration of the unique literary heritage and achievement of English-language Irish writers in the 19th and 20th centuries. Major figures of the Irish tradition: W. B. Yeats, James Joyce, Samuel Beckett, and other writers; consideration of the specifically Irish aspects of their works. *Preq:* ENGL 310 or consent of instructor.

ENGL 634 Environmental Literature 3(3,0) Survey of literature that examines the relationship between human beings and the natural world, including analysis of environmental themes in myths and legends and in selected poetry and prose of 19th- and 20th-century England and America. *Preq:* ENGL 310 or consent of instructor.

ENGL 635 Literary Criticism 3(3,0) Major critical approaches to literature. *Preq:* ENGL 310 or consent of instructor.

ENGL 636 Feminist Literary Criticism 3(3,0) Introduction to the germinal works of feminist literary theory and criticism. Outlines the development of modern literary criticism by studying feminist versions of the major critical methodologies. *Preq:* ENGL 310 or consent of instructor.

ENGL 637 Directed Studies 1-3(1-3,0) Class and tutorial work for students with special interests or projects in American, British, or European literature outside the scope of existing courses. Applications must be approved during the registration period of the semester preceding the one in which directed studies will occur. May be repeated by arrangement with the department. *Preq:* ENGL 310 or consent of instructor.

ENGL 640 Literary Theory 3(3,0) Examination of how approaches such as Marxism, Psychoanalysis, Feminism, Deconstruction, New Historicism, Post-Colonialism, Cultural Studies, and Queer Theory answer the question, "What is literature?" *Preq:* ENGL 310 or consent of instructor.

ENGL 642 Cultural Studies 3(3,0) Investigation of the similarities and connections between a wide variety of cultural products, events, and practices—from fast food through opera to on-line shopping—using theories ranging from Marxism to hybridity. *Preq:* ENGL 310 or consent of instructor.

ENGL 644 Renaissance Literature 3(3,0) Selected readings in non-Shakespearean British literature from 1500–1660. Includes drama, poetry, and prose. *Preq:* ENGL 310 or consent of instructor.

- ENGL 645 Fiction Workshop 3(3,0)** Workshop in the creative writing of prose fiction. May be repeated once for credit. *Preq:* ENGL 345 or consent of instructor.
- ENGL 646 Poetry Workshop 3(3,0)** Workshop in the creative writing of poetry. May be repeated once for credit. *Preq:* ENGL 346 or consent of instructor.
- ENGL (THEA) 647 Playwriting Workshop 3(0,3)** See THEA 647.
- ENGL 648 Screenwriting Workshop 3(2,3)** Workshop in the creative writing of screenplays. May be repeated once for credit. *Preq:* ENGL 348 or consent of instructor.
- ENGL 649 Creative Non-Fiction 3(3,0)** Advanced workshop in writing non-fiction prose for magazine and freelance markets. *Preq:* ENGL 312 or 334 or consent of instructor.
- ENGL 650 Film Genres 3(2,3)** Advanced study of films that have similar subjects, themes, and techniques, including such genres as the Western, horror, gangster, science fiction, musical, and/or screwball comedy. Also considers nontraditional genres, screen irony, genre theory, and historical evolution of genres. Topics vary. *Preq:* ENGL 357 or consent of instructor.
- ENGL (COMM) 651 Film Theory and Criticism 3(2,3)** Advanced study into the theory of film/video making emphasizing understanding a variety of critical methods to approach a film. Examines the history of film theory and defines the many schools of film criticism, including realism, formalism, feminism, semiotics, Marxism, and expressionism. *Preq:* ENGL 357 or consent of instructor.
- ENGL 652 Great Directors 3(2,3)** Intensive study of one to three film directors with an emphasis on understanding the entire canon of each director. Students study similarities in techniques, shifts in thematic emphasis, and critical methodologies for approaching the works of each director. Topics vary. *Preq:* ENGL 357 or consent of instructor.
- ENGL 653 Sexuality and the Cinema 3(2,3)** Examination of male/female sexual roles and their evolution in American genre films, avant-garde cinema, and international films. Includes the study of movies in relation to cultural values and social stereotypes, introduction to feminist film theory, and consideration of film pornography. *Preq:* ENGL 357 or consent of instructor.
- ENGL 655 American Humor 3(3,0)** Native American humor of the 19th and 20th centuries. *Preq:* 310 or consent of instructor.
- ENGL (HUM) 656 Literature and Arts of the Holocaust 3(3,0)** Addresses the Holocaust through literature, art, architecture, music, and film. Beginning with historical, political, and economic forces that contributed to the Holocaust, course then focuses on highly diverse creative responses to this event—responses that often reflect the difficulties and politics of these commemorative gestures. *Preq:* ENGL 310 or consent of instructor.
- ENGL 659 Advanced Special Topics in Language, Literature, or Culture 3(3,0)** Advanced studies in topics not central to other English courses, such as certain authors, works, genres, themes, or areas of knowledge and culture. Specific topics are announced when offered. May be repeated once for credit with department chair's consent. *Preq:* ENGL 310 or consent of instructor.
- ENGL 663 Topics in Literature to 1699 3(3,0)** Selected readings in literature from antiquity through the 17th century for focused study of authors, movements, themes, critical approaches, and genres. Topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* ENGL 310 or consent of instructor.
- ENGL 664 Topics in Literature from 1700 to 1899 3(3,0)** Selected readings in 18th and 19th century literature for focused study of authors, movements, themes, critical approaches, and genres. Special topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* ENGL 310 or consent of instructor.
- ENGL 665 Topics in Literature from 1900 3(3,0)** Selected readings in 20th and 21st century literature for focused study of authors, movements, themes, critical approaches, and genres. Topics vary and are constructed by individual faculty. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* ENGL 310 or consent of instructor.
- ENGL 675 Writing for Electronic Media 3(3,0)** Workshop in new forms of writing and hypertextual design for interactive electronic media. May be repeated once for credit at the undergraduate level. *Preq:* ENGL 310 or consent of instructor.
- ENGL 678 Digital Literacy 3(3,0)** Examines how electronic texts differ from and resemble print texts. Includes reading, studying, and analyzing print and digital texts to determine how digital techniques change patterns of reading and how readers make sense of electronic texts. *Preq:* ENGL 310 or consent of instructor.
- ENGL 682 African American Fiction and Nonfiction 3(3,0)** Critical examination of the various forms and genres of African American prose including the novel, short fiction, autobiography, nonfiction, and oratory with some attention to emerging theories about African American culture and its impact on American cultural life in general. *Preq:* ENGL 310 or consent of instructor.
- ENGL 683 African American Poetry, Drama, and Film 3(3,0)** Studies in the various forms, themes, and genres of African American poetry, drama, and film with some attention to emerging theories about African American culture and its impact on American cultural life in general. *Preq:* ENGL 310 or consent of instructor.
- ENGL 685 Composition for Teachers 3(3,0)** Practical training in teaching composition: finding workable topics, organizing and developing observations and ideas, evaluating themes, and creative writing. *Preq:* ENGL 310 or consent of instructor.
- ENGL 688 Genre and Activity Theory 3(3,0)** Examination of the forms that texts take, of the print and digital media in which they are composed, and of the ways they circulate among experts, in the public, and around the world. *Preq:* Junior standing.
- ENGL 689 Special Topics in Writing and Publication Studies 3(3,0)** Selected readings from topics in writing and publication studies, emphasizing areas such as major theories, practices, research, and critical approaches. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* ENGL 310 or consent of instructor.
- ENGL 690 Advanced Technical and Business Writing 3(3,0)** Advanced work in writing proposals, manuals, reports, and publishable articles. Students produce work individually and in groups. *Preq:* ENGL 304 or 314 or consent of instructor.
- ENGL (COMM) 691 Classical Rhetoric 3(3,0)** Study of the major texts in classical rhetoric. Examines the nature and functions of rhetoric in Greek and Roman societies. Traces the development of rhetoric from Protagoras through Isocrates, Plato, Aristotle, Cicero, and Quintilian and considers questions essential to understanding persuasive theory and practices. *Preq:* ENGL 310 or consent of instructor.
- ENGL (COMM) 692 Modern Rhetoric 3(3,0)** Examines the “new rhetorics” of the 20th century, which are grounded in classical rhetoric but which include findings from biology, psychology, linguistics, and anthropology, among other disciplines. Considers the theories and applications of communication. *Preq:* ENGL 310 or consent of instructor.
- ENGL 694 Writing About Science 3(3,0)** Advanced work in scientific writing and editing for peer and lay audiences. *Preq:* ENGL 310 or consent of instructor.
- ENGL 695 Technical Editing 3(3,0)** Practical experience in editing and preparing technical manuscripts for publication. General introduction to the functions of the technical editor. *Preq:* ENGL 314 or consent of instructor.
- ENGL 698 Studio Composition and Communication 3(3,0)** Preparation for students to work in the Class of 1941 Studio for Student Communication. *Preq:* Sophomore standing or consent of instructor.
- ENGL 700 Children's Literature for Teachers 3(3,0)** Literature for preschool through junior high.
- ENGL 800 Introduction to Research 1(1,0)** Literary history and research; use of libraries and bibliographical tools; exposition of scholarship. Required of all candidates for the Master of Arts degree and Master of Education degree with a concentration in Secondary Education—English.
- ENGL 801 Topics in Composition 3(3,0)** Principal theories and practices in modern grammar, stylistics, and semantics related to teaching composition.
- ENGL 802 Topics in Literary Genres 3(3,0)** Principal literary genres.
- ENGL 803 Topics in Rhetorical Theory 3(3,0)** Major rhetorical theories, figures, and historical movements.

- ENGL (COMM) 804 Fundamentals of Health Communication 3(3,0)** Fundamentals of health communication and the Health Communication Certificate; two theoretical bases underlying this interdisciplinary program in health communication, one based on social science theory and one based on humanities, i.e. rhetorical theory; history of both theoretical bases. *Preq:* Graduate standing or consent of Health Communication Coordinator.
- ENGL 805 Topics in Medieval Literature 3(3,0)** Principal works in verse and prose from c. 1100–1500.
- ENGL 806 Medical Rhetoric and Writing 3(3,0)** Issues in medical writing and health communication, including writing for visual and electronic media; general and specific forms and documents for professional writers in health professions. *Preq:* Graduate standing or consent of Health Communication Coordinator.
- ENGL (COMM) 807 Health Communication Campaign Planning and Evaluation 3(3,0)** Application of theories, practices, and tools developed in ENGL 804 and 806 to planning, implementing, and evaluating a public health campaign that targets a particular health practice. *Preq:* ENGL 804 and 806 or consent of Health Communication Certificate Coordinator.
- ENGL 808 Topics in Renaissance and Restoration Literature 3(3,0)** Principal works in verse and prose from c. 1500–1700.
- ENGL 811 Topics in Neoclassic and Romantic Literature 3(3,0)** Principal works in verse and prose from c. 1700–1832.
- ENGL 814 Topics in Victorian and Modern British Literature 3(3,0)** Principal works in verse and prose from c. 1832 to present.
- ENGL 820 Topics in American Literature to 1865 3(3,0)** Significant authors; works in poetry and prose; literary-intellectual movements such as Puritanism, the Enlightenment, Romanticism, and Transcendentalism from c. 1607–1865.
- ENGL 823 Topics in American Literature Since 1865 3(3,0)** Significant authors; works in poetry and prose; literary-intellectual movements such as realism, naturalism, modernism, and postmodernism from 1865 to the present.
- ENGL 831 Special Topics 3(3,0)** Topics not covered in other courses.
- ENGL 832 Topics in Scientific, Technical, and Business Writing 3(3,0)** Seminar in areas such as professional editing and publishing, writing for government and industry, teaching technical writing, and writing for journals, magazines, and newspapers.
- ENGL 833 Rhetoric of Science 3(3,0)** Rhetorical approaches to understanding science and scientific rhetorics.
- ENGL 834 Usability Testing Methodologies in Professional Communication 3(3,0)** Research methodologies used in testing the usability of professional communication.
- ENGL 835 Topics in Literary Criticism 3(3,0)** Principal statements of literary critics from the classical era to the present.
- ENGL 836 Digital Publishing Technologies: Theories in Practice 3(3,0)** User-centered design theories applied to multimedia interfaces and online documents for professional communicators.
- ENGL 838 Global Professional Communication 3(3,0)** Implications of professional communication in a global economy; theories of global professional communication; research methods for studying communication in the global workplace; models for global communicative practices.
- ENGL 839 Writing Proposals and Grant Applications 3(3,0)** Practice in reading requests for proposals, analyzing rhetorical contexts and theories of proposals, and writing proposals and grant applications.
- ENGL (A A H, COMM) 840 Selected Topics 3(3,0)** Independent/directed study; tutorial work in linguistics or American, British, or European literature not offered in other courses. *Preq:* Consent of director of MA in English program.
- ENGL 850 Research and Studies in Scientific, Business, and Technical Writing 3(3,0)** Theories of professional communication and methods of inquiry; readings and research into the ways that the writing of professionals creates new knowledge and affects the daily life of others; research methods emphasize humanistic inquiry.
- ENGL 851 Seminar in Professional Writing 3(3,0)** Advanced seminar in the principles and practice of writing and editing documents for government, industry, and the sciences; students produce projects suitable for publication, typically chosen from document design, scientific or technical journalism, and public policy writing.
- ENGL 852 Rhetoric and Professional Communication 3(3,0)** Theories of communication that have existed since classical times and that inform effective decision-making strategies in professional communication.
- ENGL 853 Visual Communications 3(3,0)** Understanding the language of images used in textual and extratextual communication; theories of perception, methods of visual persuasion, gender analysis, and cognitive and aesthetic philosophies of visual rhetoric.
- ENGL 854 Teaching Professional Writing 3(3,0)** Teaching professional writing and examining theories and practices of written, graphic, and oral communication. Students prepare course descriptions, rationales, and syllabi for teaching various forms of business, scientific, and technical writing.
- ENGL 856 Theories and Practices of Workplace Communication 3(3,1)** Workplace cultures and their theoretical and practical applications for professional communication.
- ENGL 860 The Rhetoric of Web Publishing 3(3,0)** Seminar in the theory and practice of communicating on the World Wide Web. *Preq:* ENGL 853.
- ENGL 871 Principles of Writing Assessment 3(3,0)** Focuses on a wide range of issues in writing assessment including an introduction to assessment theory, classroom issues such as grading and response, programmatic issues such as student placement and writing program assessment, and political and social contexts surrounding the highly-charged field of writing assessment.
- ENGL 872 Print and Digital Portfolios 3(3,0)** Focuses on theories, development, construction, and assessment of print and digital portfolios in educational contexts including the classroom, school reform, and other large-scale efforts, programmatic assessments, and personal/professional development. Special attention is given to ways the medium shapes reflection, presentation, connections, and artifacts within the portfolio.
- ENGL 873 Assessment of Digital Texts 3(3,0)** Writing assessment of texts integrating written, visual, audio, and digital media. Also considers implications of machine-read, -scored, and -generated texts on writing assessment.
- ENGL 874 Program Assessment 3(3,0)** Addresses practical and theoretical issues surrounding the administration and assessment of writing programs in secondary and post-secondary education. Special emphasis is given to the placement of college students into first-year writing courses and Writing Across the Curriculum program assessment.
- ENGL 875 Research Methods in Writing Assessment 3(3,0)** Presents a variety of qualitative and quantitative methods with direct applications to research in writing and program assessment. Includes constructing and implementing a multimodal research project on an assessment area.
- ENGL 876 Special Topics in Writing Assessment 3(3,0)** Selected readings from topics in writing assessment for focused study of relevant theories, research, and best practices. May be repeated for a maximum of six credits, but only if different topics are covered.
- ENGL 885 Composition Theory 3(3,0)** Teaching college-level courses, stressing contemporary composition theory, research, and practice. Required of all MA in English and MAPC Teaching Assistants.
- ENGL 886 Composition Practicum 1(1,0)** Problems in teaching Composition I and Composition II, with focus on translating theoretical concepts into creating assignments, designing curriculum, and grading. Two-semester sequence to be taken fall and spring of teaching assistantship year. Does not count toward degree. *Preq:* Graduate teaching assistantship and ENGL 885 or equivalent.
- ENGL 887 Writing Center Theory and Practice 1(1,0)** Prepares graduate students in English and Professional Communication Programs to work with students in the Writing Center. *Preq:* Graduate standing or consent of instructor.
- ENGL 891 Master's Thesis Research 1-12**
- ENGL 892 Master's Project 1-3** Required for nonthesis option in MA in Professional Communication. Requires writing a document for the professional world and keeping a log or journal as a record of the project. Students present projects to advisor. A maximum of three credits may be counted toward the degree.
- ENGL 899 Doctoral Dissertation Research 1-18**

ENTOMOLOGY

ENT (BIOSC) 600 Insect Morphology 4(3,3)

Study of insect structure in relation to function and of the variation of form in insects. Offered fall semester of even-numbered years only. *Preq:* ENT 301.

ENT 601 Insect Pests of Ornamental Plants and Shade Trees 3(2,3)

Recognition, biology, damage, and control of insect pests of woody and other ornamental plants and shade trees. Offered fall semester only. *Preq:* ENT 301.

ENT 604 Urban Entomology 3(2,3)

Study of pests common to the urban environment with emphasis on biology, damage, control, and identification of household, structural, stored products, and food pests. Students learn both theoretical and practical aspects of urban pest management and the pest-control industry. Offered fall semester of even-numbered years only. *Preq:* ENT 301.

ENT (PL PA) 606 Diseases and Insects of Turf-grasses 2(2,0)

See PL PA 606.

ENT 607 Applied Agricultural Entomology 4(3,3)

Topics include recognition, biology, damage, and control of economically important insects and mites found on major Southeastern field, fruit, nut, and vegetable crops. Principles and practices of crop protection including pesticide application, economic basis for decision making, and development of scouting programs are introduced. Offered fall semester of even-numbered years only. *Preq:* ENT 301 or equivalent.

ENT (PL PA) 608 Diseases and Insects of Turf-grasses Laboratory 1(0,3)

See PL PA 608.

ENT (BIOSC) 615 Insect Taxonomy 3(1,6)

Identification of the principal families of the major orders of adult insects. Laboratory work consists of intensive practice of such identification; lecture material deals with theoretical discussion of taxonomic features observed in the laboratory. Offered spring semester of odd-numbered years only. *Preq:* ENT (BIOSC) 400 or consent of instructor.

ENT (ENTOX) 630 Toxicology 3(3,0)

See ENTOX 630.

ENT (BIOSC) 636 Insect Behavior 3(2,3)

Fundamentals of insect behavior in an evolutionary and ecological perspective. Laboratory emphasizes generation and testing of hypotheses and observation, description, and quantification of insect behavior. Offered fall semester of odd-numbered years only. *Preq:* ENT 301 or consent of instructor.

ENT (BIOSC) 655 Medical and Veterinary

Entomology 3(2,3) Insects and their arthropod relatives which are of economic importance in their effect on man and animals. Offered fall semester of odd-numbered years only. *Preq:* ENT 301 or consent of instructor.

ENT (BIOSC, W F B) 669 Aquatic Insects 3(1,6)

Identification, life history, habitats, and interrelationships of aquatic insects; techniques of qualitative field collecting; important literature and research workers. Offered spring semester of odd-numbered years only. *Preq:* ENT 301 or consent of instructor.

ENT (GEN) 695 Insect Biotechnology 3(3,0)

Considers many unique features exhibited by insects and describes applications of biotechnology to enhance useful products from insects and to affect the control of destructive insects. *Preq:* ENT 301, GEN 302.

ENT 700 Entomology for Teachers 3(2,2)

General entomology course for secondary school science teachers with emphasis on collecting and identifying the more common insects; insect morphology, physiology, metamorphosis, and methods available for control of destructive species. Not open to Entomology majors pursuing the MS or PhD degrees. Offered spring semester only. *Preq:* Consent of instructor.

ENT 808 Taxonomy of Immature Insects 3(1,6)

Identification of immature insects emphasizing the Holometabola. Identified collection is required. Offered fall semester of odd-numbered years only.

ENT 809 Seminar in Entomology 1(1,0)

Current literature and research in entomology. Class attendance is mandatory. May be repeated for credit. To be taken Pass/Fail only.

ENT 810 Selected Topics 1-4(1-4,0)

Current areas of entomological research and pest management. May be repeated for credit. *Preq:* Consent of instructor.

ENT 843 Insect Pathology 3(2,3)

Insect diseases, their etiology, symptomatology, and epizootiology; infectious diseases caused by viruses, bacteria, fungi, and protozoa; ecological significance of these pathogens; their practical applications in medicine and agriculture. Offered fall semester of odd-numbered years only. *Preq:* ENT 301 or consent of the instructor.

ENT 853 Applied Systematics 3(2,3)

Application of evolutionary principles to resolution of contemporary zoological problems; legal issues and technical skills for efficient operation of international zoological information storage and retrieval system. Offered spring semester of even-numbered years only. *Preq:* Taxonomic course in entomology or zoology or consent of instructor.

ENT 860 Insect Pest Management 3(3,0)

Application of ecological principles to the management or control of insect populations; major factors influencing insect population fluctuations; integrated systems including biological, cultural, physical, chemical, and other techniques forming a unified multifaceted approach based on applied ecology. Offered spring semester of even-numbered years only.

ENT 863 Special Problems in Entomology 1-3(0,3-9)

Entomological research not related to thesis. *Preq:* Consent of instructor.

ENT 870 Insect Physiology and Molecular Biology 4(3,3)

Advanced instruction on the structure and function of insect physiological processes at the molecular, cellular, and tissue levels; physiological and molecular mechanisms underlying the various internal systems of insects. Laboratory emphasizes hands-on experimentation and the scientific writing technique to report experimental findings. *Preq:* BIOL 111, CH 223, ENT 301, 495, or consent of instructor.

ENT 891 Master's Thesis Research 1-12

ENT 991 Doctoral Dissertation Research 1-12

ENVIRONMENTAL AND NATURAL RESOURCES

EN R (BIOSC) 613 Restoration Ecology 3(3,0)

Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. *Preq:* Introductory course in ecology or conservation biology, consent of instructor.

EN R (FOR) 616 Forest Policy and Administration 3(3,0)

See FOR 616.

EN R (FOR) 634 Geographic Information Systems for Landscape Planning 3(2,3)

See FOR 634.

EN R 650 Conservation Issues 3(3,0)

Interactive study and discussion of issues related to the conservation of natural resources, emphasizing current issues in the conservation of biodiversity, identification of conflicting issues between consumptive and nonconsumptive resource management, and development of viable solutions for conservation of resources. *Preq:* W F B (BIOSC) 313 or consent of instructor.

ENVIRONMENTAL DESIGN AND PLANNING

EDP 801 Advanced Theory in Environmental Design and Planning 3(3,0)

Critical assessment of history and theory in the fields of design, planning, and construction. Topics include scientific knowledge, interpretive and critical inquiry, theories of urban form and human settlement. *Preq:* Master's-level course in theory related to design, planning, and construction.

EDP 805 Readings in Architecture 3(3,0)

Historical and contemporary readings in architecture designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. *Preq:* EDP 801 and consent of instructor.

EDP 806 Readings in Landscape Architecture 3(3,0)

Historical and contemporary readings in landscape architecture designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. *Preq:* EDP 801 and consent of instructor.

EDP 807 Readings in City and Regional Planning 3(3,0)

Historical and contemporary readings in city and regional planning designed to provide exposure and depth of coverage for important works in the field. May be repeated for a maximum of six credits. *Preq:* EDP 801 and consent of instructor.

EDP 809 Research Workshop in Environmental Design and Planning 3-6(1-2,6-12)

Students participate in an interdisciplinary, semester-long project to develop and apply a systematic approach to a real-world design and planning issue. A project report and presentation are prepared.

EDP 810 Contemporary Issues in Environmental Design and Planning 3(3,0)

Interdisciplinary seminar providing an overview of theory and methods related to environmental design and planning. With that background, focus is on important contemporary and emerging issues affecting the built environment. *Preq:* PO ST (C R P) 870 or consent of instructor.

EDP 812 Seminar in Environmental Design and Planning 1(1,0) Weekly colloquium to provide a forum for faculty, students, and invited speakers to address important issues of the day. May be repeated for a maximum of four credits.

EDP 815 Research Design in Environmental Design and Planning 3(3,0) Philosophy and method of scientific research. Within that context, students prepare a preliminary proposal for their dissertation research. *Preq:* EDP 801, EX ST 801, or equivalent.

EDP 816 Research Design Practicum 3(3,0) Provides an opportunity to improve and test the ability to employ the craft of research by carrying through a semester-length research project that will be the preliminary research for the student's dissertation project. *Preq:* Consent of instructor.

EDP 820 Instructional Design Delivery 3(3,0) Presents information on teaching technique including discussions of cognitive learning, motivation, course organization, interactive lecturing, and experiential learning.

EDP 991 Doctoral Dissertation Research 1-18

ENVIRONMENTAL ENGINEERING AND SCIENCE

EE&S 601 Environmental Engineering 3(3,0) Introduction to the field of environmental engineering. Topics include environmental phenomena, impact of pollutants in the aquatic environment, solid-waste management, air pollution control, radiological health, and simple water and wastewater treatment systems. *Preq:* Junior standing in engineering or consent of instructor. *Coreq:* C E 341, CH E 311, M E 308 or consent of instructor.

EE&S 602 Water and Waste Water Treatment Systems 3(3,0) Study of fundamental principles, rational design considerations, and operational procedures of the unit operations and processes employed in water and waste water treatment. Both physicochemical and biological treatment techniques are discussed. Introduction to the integration of unit operations and processes into water and waste treatment systems. *Preq:* EE&S 401; and C E 341, CH E 311, M E 308, or equivalent; or consent of instructor.

EE&S 610 Environmental Radiation Protection 3(3,0) Fundamental principles of radiological health and radiation safety. Topics include radiation fundamentals, basic concepts of environmental radiation protection, internal and external dosimetry, environmental dose calculations, and radiation protection standards. Offered fall semester only. *Preq:* Consent of instructor.

EE&S 611 Ionizing Radiation Detection and Measurement 3(2,3) Laboratory exercises in ionizing radiation detection and measurements. Topics include nuclear electronics; counting statistics; radiation interactions; basic gas, scintillation, and semiconductor detectors; gamma-ray spectroscopy; health physics survey instrumentation; and thermoluminescent dosimetry. Offered spring semester only. *Preq:* EE&S 410 or consent of instructor.

EE&S 630 Air Pollution Engineering 3(3,0) Introductory course in air pollution and its control. Topics include air pollutants and effects, sources, dispersion models, engineering controls, and air-quality legislation. *Preq:* Senior standing in engineering or physical sciences.

EE&S (B E, FOR) 651 Newman Seminar and Lecture Series in Natural Resources Engineering 1(0,2) See B E 651.

EE&S 680 Environmental Risk Assessment 3(3,0) Quantitative estimation of the human health risk posed by the release of a contaminant to the environment. Topics include methods for analyzing emission rate, environmental transport, exposure, and health effects; methods of uncertainty analysis; and the role of risk assessment in environmental regulation and environmental decision making. *Preq:* EE&S 401 or consent of instructor.

EE&S (B E) 684 Municipal Solid Waste Management 3(3,0) Introduction to the problems, regulations, collection, handling, recycling, and disposal of municipal solid wastes in the urban and rural sectors. Emphasis is on integrated waste-management systems with resource recovery, composting, incineration, landfill disposals, and their costs. *Preq:* Senior standing in engineering or science or consent of instructor.

EE&S 685 Hazardous Waste Management 3(3,0) Introduction to problems, regulations, treatment, and ultimate disposal of hazardous and toxic materials. Spill cleanup, groundwater transport, land disposal, incineration, and treatment technologies are discussed. Offered spring semester only. *Preq:* EN SP 200 or EE&S 401 or consent of instructor; two semesters of general chemistry.

EE&S 686 Pollution Prevention and Industrial Ecology 3(3,0) Topics include pollution prevention technology, the role of pollution prevention within a corporation, source reduction and recycling, pollution prevention assessments, treatment to reduce disposal, life-cycle assessment, design for environment, industrial ecology. Emphasis is on case studies. *Preq:* Senior standing in College of Engineering and Science.

EE&S 690 Special Projects 1-3(1-3,0) Studies or laboratory investigations on special topics in the environmental engineering and science field. Arranged on a project basis with a maximum of individual student effort and a minimum of staff guidance. May be repeated for a maximum of three credits. *Preq:* Consent of instructor.

EE&S 701 Special Problems 1-6(1-6,0) Environmental engineering problems selected to meet the interests and experience of students and instructor. Formal report is required. Restricted to MEngr students. To be taken Pass/Fail only.

EE&S 802 Environmental Engineering Principles 3(3,0) Fundamental principles required for simulation and modeling of environmental engineering phenomena; mass transfer, reactor kinetics, simulation techniques, and applications to various natural and engineered systems. Offered fall semester only.

EE&S 803 Physicochemical Operations in Water and Wastewater Treatment Systems 3(3,0) Principles of physicochemical operations used in water and wastewater treatment including sedimentation, filtration, mixing, gas transfer, adsorption, ion exchange, coagulation, precipitation, disinfection, and oxidation. Offered spring semester only. *Preq:* EE&S 802, 843.

EE&S 804 Biochemical Operations in Wastewater Treatment Systems 3(3,0) Principles of biochemical operations used in wastewater treatment; modeling of ideal biochemical reactors and design criteria for aerated lagoons, activated sludge, trickling filters, rotating biological contactors, nitrification, denitrification, and digestion. Offered spring semester only. *Preq:* EE&S 802, 851.

EE&S 805 Laboratory in Water and Wastewater Treatment Operations 3(0,6) Laboratory exercises in selected water and wastewater treatment operations including sedimentation, filtration, adsorption, coagulation, softening, aeration, activated sludge, aerobic digestion, and anaerobic digestion. Offered spring semester only. *Coreq:* EE&S 803 or 804.

EE&S 806 Process and Facility Design for Environmental Control Systems 2-4(2-4,0) Integration of unit operations into complex systems for treatment of industrial/domestic water and wastewater, contaminated groundwater or air, landfill leachate, and toxic liquid wastes. Student teams design an integrated system for either water/wastewater or a hazardous/toxic waste. Offered fall semester only. *Preq:* EE&S 803, 804.

EE&S (GEOL) 808 Groundwater Modeling 3(3,0) See GEOL 808.

EE&S (GEOL) 809 Subsurface Remediation Modeling 3(3,0) See GEOL 809.

EE&S (GEOL) 810 Analytical Methods for Hydrogeology 3(3,0) See GEOL 810.

EE&S 812 Environmental Nuclear Engineering 3(3,0) Environmental aspects of nuclear technology emphasizing nuclear reactors and the nuclear fuel cycle; environmental transport of radioactive materials; radioactive effluents from nuclear power plants; nuclear power plant safety; environmental aspects of fuel cycle activities; waste management. Offered fall semester only. *Preq:* EE&S 610, consent of instructor.

EE&S 813 Environmental Radiation Protection Laboratory 3(1,6) Continuation of EE&S 611; advanced experiments in radiation detection, radiation protection, health physics, and environmental monitoring. Offered fall semester only. *Preq:* EE&S 611 and consent of instructor.

EE&S (CH E) 814 Applied Numerical Methods in Process Simulation 3(3,0) See CH E 814.

EE&S 815 Actinide Chemistry 3(3,0) Chemical and physical aspects of actinide metals and compounds (including properties, structure and bonding, reactions, kinetics, thermodynamics), coordination and solution chemistry, behavior and speciation in the environment, separation and purification, chemistry of the nuclear fuel cycle and waste treatment, and related topics; fundamental concepts, history, and recent developments. *Preq:* CH 402, MTHSC 208, PHYS 221, or consent of instructor.

- EE&S 820 Environmental Systems Analysis 3(3,0)** Analysis of a systems view of environmental problems, with particular emphasis on conflicting objectives such as economic and environmental concerns. Example problems span traditional environmental engineering processes, natural resources, proactive environmental management, and sustainability. *Preq:* MTHSC 311 or consent of instructor.
- EE&S 832 Air Pollution Meteorology 3(3,0)** Applications of meteorology to air pollution; micrometeorology; plume rise modeling; atmospheric diffusion; deposition and washout of pollutants; air chemistry; applications of diffusion modeling to air quality planning. *Preq:* Consent of instructor.
- EE&S 833 Air Pollution Control Systems 3(3,0)** Principles and design of air pollution control equipment including mechanical collectors, electrostatic precipitators, baghouse filters, wet scrubbers, adsorbers, and incinerators. Offered spring semester only. *Preq:* EE&S 430 or consent of instructor.
- EE&S 834 Particles in the Atmosphere 3(3,0)** Chemical and physical behavior of atmospheric particles and their interaction with other particles, gases and light; generation, measurement methods, and control strategies of atmospheric particles. *Preq:* EE&S 630, MTHSC 208, or consent of instructor.
- EE&S 837 Biodegradation and Bioremediation 3(3,0)** Basic principles of biodegradation for major classes of organic contaminants including halogenated aliphatics and aromatics, fuel hydrocarbons, pesticides, and nitrated energetic compounds; biotransformations of metals; biodegradation principles applied to the development of bioremediation technologies including intrinsic, in situ, and on-site engineered approaches. *Preq:* EE&S 851.
- EE&S 843 Environmental Chemistry 3(3,0)** Principles of chemical kinetics and thermodynamics applied to fundamental understanding of aqueous environmental samples including natural waters, wastewaters, and treated waters; factors controlling chemical concentrations, acid-base equilibria, solubility equilibria, complex formation, electrochemistry, adsorption phenomena. Offered fall semester only. *Preq:* CH 102 or equivalent.
- EE&S 844 Environmental Chemistry Laboratory I 3(2,3)** Laboratory experience in basic analytical methods used in water quality studies; experimental design, sampling, wet-chemical analytical techniques, data collection and analysis, data interpretation, and data quality techniques. Offered fall semester only. *Preq:* Two semesters of general chemistry.
- EE&S 845 Environmental Organic Chemistry 3(3,0)** Application of parameters that describe the equilibrium distribution and exchange rates for environmentally significant organic compounds to the modeling of processes in engineered and natural systems, including environmental parameter estimation techniques, structure-activity relationships, and integration of environmental processes to model contaminant distribution and residence time in environmental systems. Offered spring semester only. *Preq:* Two semesters of general chemistry, EE&S 843 or equivalent.
- EE&S 847 Advanced Environmental Chemistry 3(3,0)** Advanced principles and methods in environmental engineering chemistry with applications to both natural and treatment systems; current investigative and study techniques; nature, fluxes, and controlling processes of chemical species and radionuclides in environmental systems. *Preq:* EE&S 843 or equivalent.
- EE&S 849 Environmental Chemistry Laboratory II 3(1,6)** Theory and applications of instrumental methods of analysis as applied to measurements for environmental control; spectroscopy and spectrophotometric techniques; electrochemical analyses; chromatographic methods of analysis; light scattering and electrophoretic measurements. Offered fall semester only.
- EE&S 850 Stream and Estuarine Analysis 3(3,0)** Physical, chemical, and biological processes and relationships which exist in streams and estuaries; estuarine environment; free-flowing streams; mechanisms describing transport of conservative and nonconservative materials through estuarine systems; the estuary as a resource and techniques for its management. Offered fall semester only.
- EE&S 851 Biological Principles of Environmental Engineering 3(3,0)** Basic principles of biology and biochemistry as applied to problems of environmental control and wastewater treatment; kinetic and energetic aspects. Offered fall semester only.
- EE&S 852 Subsurface and Wetland Hydraulics 3(3,0)** Hydraulics of subsurface water including hydraulic head and gradient concepts, Darcy's Law, saturated/unsaturated flow, flow in aquifers and aquitards, flow to wells, and interactions with surface water in wetlands including discharge and development of seepage faces. Mathematics is at the level of elementary ordinary and partial differential equations. *Preq:* Differential equations, fluid mechanics or EE&S 802 or consent of instructor.
- EE&S 855 Surface and Subsurface Transport 3(3,0)** Quantitative analysis of reactive transport and biodegradation in ground water and surface water; applications of the advection-dispersion equation with reaction terms including classical chemical reactions, radioactive decay, and reactions mediated by microbes. *Preq:* C E 340 and MTHSC 208 or equivalent.
- EE&S 856 Pollution of the Aquatic Environment 3(3,0)** Effects of domestic and industrial water pollution on the physical, chemical, and biological characteristics of natural waters; associated environmental determinants of human disease, toxicology, and epidemiology of chronic disease. Offered fall semester only.
- EE&S 861 Environmental Engineering and Science Seminar 1(1,0)** Current advances and research developments in various areas of environmental engineering and science. Off-campus speakers, students, and faculty participate. To be taken Pass/Fail only.
- EE&S 880 Environmental Risk Assessment 3(3,0)** Methodology of quantitative risk assessment including identification and quantification of the source term, calculation of environmental transport, and estimation of health effects. Applications involve various classes of contaminants in atmospheric and aquatic environmental pathways. Offered spring semester only. *Preq:* MTHSC 208, graduate standing in engineering or science.
- EE&S 881 Special Problems 1-4** Problems selected to meet interests and experiences of student and instructor.
- EE&S 883 Selected Topics in Environmental Engineering 1-4(1-4,0)** Topics in environmental engineering not covered in other courses. Topics vary to keep pace with current developments. May be taken concurrently with EE&S 884, which (if offered) would be a different topic.
- EE&S 884 Selected Topics in Environmental Engineering 1-4(1-4,0)** Topics in environmental engineering not covered in other courses. Topics vary to keep pace with current developments. May be taken concurrently with EE&S 883, which (if offered) would be a different topic.
- EE&S 891 Master's Thesis Research 1-12**
- EE&S 961 Environmental Engineering and Science Doctoral Student Seminar 1(1,0)** Current advances and research developments in various areas of environmental engineering and science. Doctoral students are required to enroll each semester that the course is offered and present one seminar per year. To be taken Pass/Fail only.
- EE&S 991 Doctoral Dissertation Research 1-12**

ENVIRONMENTAL SCIENCE AND POLICY

- EN SP 672 Environmental Planning and Control 2(2,0)** Application of planning and control to effective environmental quality improvement. Water supply and treatment, wastewater treatment and disposal, solid waste disposal, air pollution abatement, and land use and zoning are considered from the standpoint of control. Not intended for graduate students in engineering. *Preq:* Consent of instructor.

ENVIRONMENTAL TOXICOLOGY

- ENTOX 600 Wildlife Toxicology 3(3,0)** Assessment of impacts of toxic substances on reproduction, health, and well-being of wildlife species; acute and chronic effects of agricultural chemicals, pesticides, hazardous waste, industrial waste, and oil releases are discussed. *Preq:* BIOCH 305 or organic chemistry, one year of general biology, W F B 350 or consent of instructor.
- ENTOX 621 Chemical Sources and Fate in Environmental Systems 3(3,0)** Chemical cycles in the environment are discussed on global and microcosm scales. The dependence of fate processes on physical and chemical properties and environmental conditions is examined. Breakdown, movement, and transport of selected toxicants are addressed to illustrate the mechanisms that govern chemical fate. *Preq:* Organic and analytical chemistry or consent of instructor.

- ENTOX (ENT) 630 Toxicology 3(3,0)** Basic principles of toxicology including quantitation of toxicity, toxicokinetics, biochemical action of poisons, and environmental toxicology are studied. Acute and chronic effects of various classes of poisons are discussed (e.g., pesticides, drugs, metals, and industrial pollutants) in relation to typical routes of exposure and regulatory testing methods. Offered fall semester of odd-numbered years only. *Preq:* Organic chemistry, one year of general biology, or consent of instructor.
- ENTOX 637 Ecotoxicology 3(3,0)** Study of the effects of stressors on the ecosystem. Explores the integrative relationships that comprise the field of ecotoxicology in a hierarchical format that focuses on the various levels of ecological organization. *Preq:* ENTOX 430 or consent of instructor.
- ENTOX (CSENV) 685 Environmental Soil Chemistry 3(3,0)** See CSENV 685.
- ENTOX 801 Advanced Wildlife Toxicology 3(1,6)** Interactions between chemical contaminants and wildlife species focusing on effects at the organismal, species, trophic, community, and ecosystem level. Field and laboratory techniques that professional wildlife toxicologists use are emphasized. *Preq:* ENTOX 400, 430.
- ENTOX (BIOSC) 811 Immunotoxicology 3(3,0)** Study of how environmental contaminants, drugs, and natural biotoxins affect the immune system of man and animals; cellular and molecular mechanisms of action by immunotoxic agents. *Preq:* AVS 825, ENTOX 630, consent of instructor.
- ENTOX 822 Analytical Toxicology Laboratory 3(1,6)** Laboratory instrumentation, procedures, and experimental methods used for identification and quantitation of toxic substances and their transformation products in environmental and biological samples; application of these procedures in the isolation, detection, and quantitation of toxicants in authentic samples. *Preq:* Organic and analytical chemistry or consent of instructor; instrumental analysis recommended.
- ENTOX (BIOSC) 830 Mechanistic Toxicology 3(3,0)** Detailed biochemical toxicology: control, regulation, and activity of metabolic enzymes; molecular and cellular mechanisms of toxic action; proposed mechanisms for initiation and development of cancer; mode of action and kinetics of cholinesterase inhibitors; structure/activity relationships of ion channel blockers; biochemical and molecular biomarkers. *Preq:* ENTOX (ENT) 430.
- ENTOX (BIOSC) 831 Biomarkers in Toxicology 3(1,6)** Methodology used in biomarker identification and evaluation of the effects of toxic substances on living systems using biomarkers in sentinel organisms and surrogate biomarkers. *Preq:* Organic chemistry and biochemistry with laboratory; ENTOX 400 or (ENT) 430; or consent of instructor.
- ENTOX 841 Procedures and Techniques in Ecological Risk Assessment 2(1,3)** Evaluation and application of the procedures and techniques used in ecological risk assessments, including laboratory and field methods, to determine, measure, and evaluate the risks to aquatic, terrestrial, and avian species; impacts to biota within, and resulting from, chemical waste disposal facilities and hazardous waste sites. *Preq:* CH 223, 224, 313; EX ST 804 or 805; ENTOX (ENT) 630; or consent of instructor.
- ENTOX 852 Ecological Models 3(2,3)** Systems analysis applied to ecology; construction of models which predict ecological consequences of stresses to the environment; frequency response analysis, energy models, information flow, and transfer functions for population interactions. *Preq:* Course in ecology and in computer programming or consent of instructor.
- ENTOX (BIOSC) 854 Aquatic Toxicology 3(3,0)** Combines concepts of solution chemistry with toxicology to establish stressor-response relationships for aquatic organisms at various trophic levels. Bioavailability is a unifying concept, and concepts of contaminant exposure and organism response are set in an ecological risk assessment framework.
- ENTOX 855 Sediment Toxicology and Chemistry 3(3,0)** Focuses on the chemistry and toxicology of contaminants in freshwater sediments. Sediment geochemistry, ecology, toxicity bioassay methodology, and sediment sampling are discussed in a course framework that deals directly with contaminant bioavailability questions. *Preq:* ENTOX 854 or consent of instructor.
- ENTOX 860 Graduate Seminar 1(1,0)** Recent research in environmental toxicology; presentation, review, and discussion of current issues by graduate students in an area of specialization selected by the instructor. May be repeated four times for credit. To be taken Pass/Fail only.
- ENTOX 861 Departmental Seminar 1(1,0)** Presents current research by Department of Environmental Toxicology faculty, staff, finishing graduate students, and invited speakers. Improves students' skills in evaluation of research plans and oral presentations and increases their awareness of literature resources and employment opportunities in the field. May be repeated four times for credit.
- ENTOX 863 Selected Topics 1-4(0-4,0-6)** Topics in environmental toxicology not covered in other courses. Topics vary with current developments in the discipline. May be repeated, but only if different topics are covered. *Preq:* Consent of instructor.
- ENTOX 891 Master's Thesis Research 1-12**
- ENTOX 991 Doctoral Dissertation Research 1-12**
- EXECUTIVE LEADERSHIP AND ENTREPRENEURSHIP**
- E L E 600 Technology Entrepreneurship 3(3,0)** Introduction to technology entrepreneurship with emphasis on ideation, opportunity assessment, market and technology forecasting, intellectual property protection, financial modeling and business valuation, project management, and cross-functional team building. Open to science and engineering majors only. *Preq:* Junior standing.
- E L E 800 Special Topics in Technology Entrepreneurship 1-6(1-6,0)** Comprehensive study of a topic of current interest in technology entrepreneurship. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* E L E 400.
- EXPERIMENTAL STATISTICS**
- EX ST 602 Introduction to Statistical Computing 3(3,0)** Introduction to statistical computing packages. Topics include data importation, basic descriptive statistic computation, basic graphic preparation, and statistical analysis methods and procedures. *Preq:* EX ST 301.
- EX ST 611 Statistical Methods for Process Development and Control 3(3,0)** Experimental design techniques for use in process development, application of screening experiments and response surface experiments, techniques for process control with implications for product quality control. Includes discussions of the use of statistical computer analyses and interpretations including computer-generated graphics. *Preq:* MTHSC 206 or consent of instructor.
- EX ST 801 Statistical Methods I 4(3,3)** Role and application of statistics in research; estimation, test of significance, analysis of variance, multiple comparison techniques, basic designs, mean square expectations, variance components analysis, simple and multiple linear regression, and correlation, and nonparametric procedures. *Preq:* Consent of instructor.
- EX ST 802 Statistical Methods II 3(3,0)** Extended coverage of several methods introduced in EX ST 801: multiple regression model building and diagnostics, experiment design and analysis, and nonparametric methods; mixed models and repeated measures analyses; categorical data analysis; multivariate methods and sampling designs; appropriate use of statistical software. *Preq:* EX ST 801.
- EX ST 803 Regression and Least Squares Analysis 3(3,0)** Regression analysis: simple and multiple linear, curvilinear and multiple curvilinear; curve fitting; least squares and computer techniques for fitting of constants and analysis of planned experiments. Offered spring semester only. *Preq:* EX ST 801.
- EX ST 804 Sampling 3(3,0)** Principles of scientific sampling; finite population sampling; simple random, stratified, multistage, and systematic sampling; optimum allocation; methods of obtaining, processing, and reporting survey information; sampling as related to the environment, natural resources, and social and economic problems. *Preq:* EX ST 801.

EX ST 805 Design and Analysis of Experiments 3(3,0) Basic designs and analysis; data transformations; single degree of freedom, orthogonality and responses in ANOVA; covariance; response surfaces; incomplete blocks; introduction to least squares analysis of experiments; uses of standard computer programs for selected analyses. *Preq:* EX ST 801.

EX ST 811 Special Problems in Experimental Statistics 1-3(0,2-6) Statistical aspects of an individualized research problem; determining an appropriate experimental design; performing proper analyses and generating effective reports.

EX ST 812 Selected Topics 1-3(1-3,0) Topics in applied statistics not covered in other courses. May be repeated, but only if different topics are covered.

EX ST 815 Environmental and Ecological Statistics 3(3,0) Overview of statistical techniques in Environmental Science and Ecology. Probability distributions and sampling; population estimation using capture/recapture, line transect, and line intercept methods; spatial point pattern analysis; modelling environmental and ecological data; environmental monitoring. *Preq:* EX ST 801 and 803 or consent of instructor.

EX ST 816 Spatial Statistics 3(3,0) Introduction to spatial data analysis emphasizing concepts and interpretation, spatial point processes, clustering, spatial autocorrelation, semivariograms, kriging, spatial regression, and analysis of variance. *Preq:* EX ST 801 and 803 or consent of instructor.

EX ST 817 Multivariate Statistics in Agriculture, Forestry, and Natural Resources 3(3,0) Application of multivariate techniques for linear models (MANOVA, Hotellings T²), covariance structure (principal components, factor analysis), classification (discriminant and cluster analyses), and structural equation modeling drawing examples from life sciences, natural resources, tourism, and related programs. *Preq:* EX ST 801 and 803 or consent of instructor.

EX ST 819 Biostatistics 3(3,0) Statistical analyses applicable to disease/mortality occurrence. Introduction to epidemiology study designs and appropriate statistical analyses. Statistical methodology applicable to life-tables and survival curves and clinical trials. *Preq:* EX ST 801.

FAMILY AND COMMUNITY STUDIES

FCS 810 Life in the Global Community 3(3,0) Examines global perspectives and trends related to social, psychological, and physical well being of children, youth, adults, families, primary institutions of society, and civil society. Considers accommodation and resistance to globalization as well as analysis and comparative review of the effects of globalization on everyday life in selected countries.

FCS 811 Human Development and Family Life in Cultural Context 3(3,0) Examines cultural context in human development and family life; the impacts of culture on physical, cognitive, and social development; the influences of different environmental experiences on individual and family functioning; practical applications of a cross-cultural human and family development perspective; and the state of human development around the world. *Preq:* FCS 810.

FCS 812 Democracy and the Growth of Civil Society 3(3,0) Study of democracy as a political system and a way of life. Examines the nature of civil society and its relation to the development and sustainability of democratic values and institutions and the cultural, economic, and political correlates of civic participation at various points in the lifespan. *Preq:* FCS 810 or consent of instructor.

FCS 820 International Human Rights Law 3(3,0) Examines international human rights law, the origins of international human rights, the emergence of international human rights law, issues related to the implementation, the position of the U.S. regarding ratification of human rights treaties, processes for monitoring and implementing human rights, and treatment of human rights in the courts.

FCS 821 International Law and Policy on Children's Issues 3(3,0) Comparative analysis of law and policy on children's issues. Attention is given to relevant international instruments, particularly the Convention on the Rights of the Child, and to related concepts in the law and policy of various nations, including the United States. *Preq:* FCS 820.

FCS 822 Right to Health 3(3,0) Examination of the relationship between health and human rights emphasizing the application of a rights-based approach to health-related interests of children, families, and communities. Topics include discussion of the content and contours of a right to health and of emerging trends in health and human rights. *Preq:* FCS 820 or consent of instructor.

FCS 830 Community Development: Principles and Practices 3(3,0) Comparative theory and practice of community development, community building, and community transformations that support child, youth, and family well-being. Includes U.S. community development examples with selected examples from other nations.

FCS 831 Community Transformation 3(3,0) Advanced course on community transformation theories, theologies, and practice. Discusses and illustrates major paradigm shifts within the last three decades in the way community development is thought about and done. Case studies on community transformation from selected nations are utilized. *Preq:* FCS 830 or consent of instructor.

FCS 832 Policies and Programs in Human Services 3(3,0) Philosophy, theories, and principles for organizing human services in and across selected nations, emphasizing strategies for and barriers to the development of collaborations among and between governmental and nongovernmental organizations. Discusses community-level child and family support, poverty alleviation, health care, early childhood education care, and old-age assistance. *Preq:* FCS 830 or consent of instructor.

FCS 833 Humanitarian Assistance 3(3,0) Introduction to humanitarian assistance. Topics include historical background, current status, determinants, legal issues, and health and social service delivery to current and past refugee and internally-displaced people, and ethno-political conflicts and terrorism as major sources of humanitarian crises. *Preq:* FCS 830 or consent of instructor.

FCS 835 Religious Institutions in Community Life 3(3,0) Focuses primarily on comparative review of religious organizations as core institutions in everyday life and community well-being; the personal, social, and political meaning of religious involvement; the theological frameworks motivating faith-based organizations' involvement in community development; the effects of globalization on normative religious behavior related to social action.

FCS 840 Community, Societal, and International Research 3(3,0) Covers issues and methods of community, societal, and international research and evaluation; macro-level assessment of the impact of interventions and the documentation of change; multi-method etic and emic strategies, theory-based evaluation, longitudinal designs, and collaborative, consultative models of research. *Preq:* PSYCH 810, 811; or consent of instructor.

FCS 890 Research Project 1-6 Research in Family and Community Studies not related to a thesis.

FCS 892 Special Topics 1-3(1-3,0) Selected current and classic topics not covered in other courses. May be repeated for a maximum of 12 credits, but only if different topics are covered.

FCS 893 Practicum 3 Comprehensive community building projects involving a group of Family and Community Studies majors working with a faculty member and community leaders. *Preq:* Consent of instructor.

FCS 894 Internship 0 Students spend at least one academic year in residence at an affiliated center outside North America. Capstone learning experiences are done in connection with the internship experience, in part through distance learning. To be taken Pass/Fail only. *Preq:* FCS 810, 820, 830, 840, consent of graduate studies coordinator.

FCS 896 Independent Study 1-6(1-6,0) Individual readings or research on a topics selected according to the student's interests or professional development needs. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* Consent of coordinator of graduate studies.

FCS 991 Doctoral Research 1-18

FINANCE

FIN 602 Advanced Corporate Finance 3(3,0) Study of the decision process and analytical techniques used in evaluating corporate investment and making financial decisions. Topics include capital budgeting, real options, working capital management, mergers and acquisitions, bankruptcy and reorganization, and financial management in not-for-profit businesses. *Preq:* FIN 312 with a C or better or consent of instructor.

FIN 606 Analysis and Use of Derivatives 3(3,0)
Consideration of the option pricing theory and strategy techniques most commonly used in the market for options. An overview of the futures markets is also considered. Special emphasis is given to interest-rate futures, stock-index futures, and foreign-exchange futures. *Preq:* FIN 305 with a C or better or consent of instructor.

FIN 615 Real Estate Investment 3(3,0) Focuses on the structure and analysis of real estate investment emphasizing financial theory and analysis technique. Case study and project-oriented homework assignments facilitate the understanding of real estate investments. *Preq:* FIN 307 with a C or better or consent of instructor.

FIN 616 Real Estate Valuation 3(3,0) Advanced course in commercial real estate valuation. Topics include income capitalization, cash equivalency, highest and best use analysis, the cost approach, the direct sales comparison approach, and DCF analysis. *Preq:* FIN 307 with a C or better or consent of instructor.

FIN 617 Real Estate Finance 3(3,0) Advanced course applying financial analysis and theory to real estate. Mortgage credit analysis and current financing techniques for residential and commercial properties are emphasized. Topics include financial institutions, syndications, and construction financing. *Preq:* FIN 307 with a C or better or consent of instructor.

FIN (M B A) 832 International Financial Management 3(3,0) See M B A 832.

FIN (M B A) 836 Real Estate Principles 3(3,0)
See M B A 836.

FIN 867 Advanced Financial Management 3(3,0)
Financial problem-solving skills developed through case analysis, class discussion, reading assignments, and a project. *Preq:* M B A (FIN) 807 or 857 or consent of instructor.

FOOD SCIENCE

FD SC 601 Food Chemistry I 4(3,3) Basic composition, structure, and properties of food and the chemistry of changes occurring during processing utilization. Offered fall semester of even-numbered years only. *Preq:* BIOCH 305 or consent of instructor.

FD SC 602 Food Chemistry II 4(3,3) Application of theory and procedures for quantitative and qualitative analysis of food ingredients and food products. Methods for protein, moisture, lipid, carbohydrate, ash, fiber, rancidity, color, and vitamin analyses and tests for functional properties of ingredients are examined. Offered spring semester of odd-numbered years only. *Preq:* BIOCH 305 or consent of instructor.

FD SC 604 Food Preservation and Processing 3(3,0) Principles of food preservation applied to flow processes, ingredient functions, and the importance of composition and physical characteristics of foods related to their processing; product recalls and product development concepts. *Preq:* Physics and organic chemistry or biochemistry.

FD SC 606 Food Preservation and Processing Laboratory 1(0,3) Laboratory exercises on preservation methods, equipment utilized, and processes followed in food manufacture. *Coreq:* FD SC 404.

FD SC 607 Quantity Food Production 2(1,3)
Principles of the production of food in quantity for use in food service systems, Emphasis is on functions of components of foods and of ingredients in food, on the quality of the final product, on safe production of food, and on proper use of equipment. *Coreq:* FD SC 306, 404.

FD SC 608 Food Process Engineering 4(3,3)
Study of basic engineering principles and their application in food processing operations. The relation between engineering principles and fundamentals of food processing is emphasized. *Preq:* FD SC 214, CH 102, MTHSC 106, PHYS 207 or 200 or 122 or consent of instructor.

FD SC 630 Dairy Processing I 4(3,3) Processing and distribution of fluid milk and other dairy products with emphasis on composition, quality control, chemical, microbiological, and public health aspects. *Preq:* BIOL 104/106, CH 102.

FD SC 631 Dairy Processing II 4(3,3) Continuation of FD SC 430, with emphasis on processing of cultured dairy products and frozen dairy products. Discusses processing procedures, quality control, ingredients, formulations, and compositional and cultural characteristics of cultured and frozen dairy products. *Preq:* FD SC 430.

FD SC 810 Chemical and Biochemical Aspects of Foods 4(4,0) Chemical, biochemical, and functional properties of food components and their interactions in food emulsions, foams, colloids, and gel and solution states; the influences of processing on isolation, utilization, and production of the constituents using techniques based on constituent properties. *Preq:* BIOCH 623 and FD SC 401 or consent of instructor.

FD SC 811 Physical and Thermophysical Properties of Foods 3(3,0) Principles involved in relating physical and thermophysical properties to food quality. Includes standard methods and instruments to determine texture and the relationship of physical properties to sensory evaluation; interrelationships of chemical structure and physical properties in food processing operations. *Preq:* FD SC 810 or consent of instructor.

FD SC 812 Microbiological Aspects of Food Systems 3(3,0) Function and characteristics of microorganisms in the utilization and manufacture of food products; food fermentations, microbially induced chemical and physical changes, environmental aspects, and production of food ingredients and resources. *Preq:* MICRO 407 or equivalent or consent of instructor.

FD SC 815 Food Service Systems Management 4(3,3) Management of the procurement, production, distribution, and service of food that meets nutrition guidelines, cost parameters, and consumer acceptance criteria; supervision of customer satisfaction systems, marketing functions, and human resource systems.

FD SC 820 Selected Topics in Food Science 1-3(1-3,0) Special topics in food science not covered in other courses. May be repeated for a maximum of nine credits.

FD SC 821 Selected Topics 1-4(0,3-12) Independent research investigation in food science areas not conducted in other courses. May be repeated for a maximum of 12 credits. *Preq:* Consent of instructor.

FD SC 851 Food Science Seminar 1(1,0) Current research and related developments in food science reviewed by faculty, students, and invited lecturers.

FD SC 852 Food Science Seminar 1(1,0) Continuation of FD SC 851.

FD SC 891 Master's Thesis Research 1-12

FOOD TECHNOLOGY

FD TH 851 Food Technology Seminar 1(1,0)
Current and ongoing research and developments in food technology reviewed by faculty, students, and invited lecturers. *Preq:* Enrollment in the Food Technology PhD program or consent of instructor.

FD TH 991 Doctoral Dissertation Research 1-12

FORESTRY

FOR 600 Public Relations in Natural Resources 3(3,0) Identifying relevant policies, their characteristics and acceptance to natural resource management, and techniques of maintaining appropriate public relations. *Preq:* Senior standing.

FOR 608 Wood and Paper Products 3(3,0) Study of wood structures and identification; physical and mechanical properties of wood products; standard testing procedures; manufacture of lumber, plywood, oriented strand board; drying, preservation, grading, and use of wood products. Also discusses common grades of paper and paperboard; fiber sources; pulping and paper-making equipment and processes; chemical recovery process; and environmental issues. *Preq:* Junior standing or consent of instructor.

FOR 610 Harvesting Processes 4(3,3) Study of forest harvesting processes with detailed analysis of production, cost, environmental impacts, safety, transportation, and business considerations. *Preq:* Senior standing or consent of instructor.

FOR 613 Integrated Forest Pest Management 4(3,3) Nature and control of pests of forest trees and products. Focuses on the relation of pests to silviculture, management, and natural forest ecosystems. Offered fall semester only. *Preq:* Junior standing in Forest Resource Management.

FOR 615 Forest Wildlife Management 3(2,3) Principles, practices, and problems of wildlife management with emphasis on upland forest game species. Habitat manipulation through use of appropriate silvicultural practices in association with other techniques is evaluated. *Preq:* FOR 460 or consent of instructor.

FOR (E N R) 616 Forest Policy and Administration 3(3,0) Introduction to development, principles, and legal provisions of forest policy in the United States and an examination of administrative and executive management in forestry.

FOR 617 Forest Resource Management and Regulation 3(3,0) Fundamental principles and analytical techniques in planning, management, and optimization of forest operations. *Preq:* FOR 302, 308, 418, 460.

- FOR 618 Forest Resource Valuation 3(3,0)**
Analysis of capital investment tools and their application to decision making among forestry investment alternatives; valuation of land, timber, and other resources associated with forestry, including the impact of inflation and taxes. *Preq:* FOR 304 or consent of instructor.
- FOR 623 Current Issues in Natural Resources 2(2,0)**
Lectures in various fields of forestry delivered by selected representatives from forest industries, consultants, agencies, associations, and other forestry operations. Course will not be taught when enrollment is less than 15. To be taken Pass/Fail only. Offered fall semester only. *Preq:* Junior standing or consent of instructor.
- FOR (HORT) 627 Urban Tree Care 3(3,0)**
Principles, practices, and problems of protecting and maintaining trees in urban and recreational areas. Examines environmental and biological factors affecting trees in high-use areas, their management and cultural requirements, and the practices necessary for their protection and care as valuable assets in the landscape. *Preq:* Junior standing or consent of instructor.
- FOR 631 Recreation Resource Planning in Forest Management 2(1,3)**
Analysis of forest recreation as a component of multiple-use forest management; techniques of planning; physical and biological effects on forest environments; and forest site, user, and facility management. Offered spring semester of odd-numbered years only.
- FOR 633 GPS Applications 3(2,3)**
Develops competence in global positioning system (GPS) technology including theory, methods, and application to natural resources mapping. Topics include basic concepts of GPS; projection systems; types of data; mission planning; and data capture, correction, and export to geographical information systems (GIS). *Preq:* Senior standing or consent of instructor.
- FOR (E N R) 634 Geographic Information Systems for Landscape Planning 3(2,3)**
Develops competence in geographic information systems (GIS) technology and its application to various spatial analysis problems in landscape planning. Topics include data development and management, spatial analysis techniques, critical review of GIS applications, needs analysis and institutional context. GIS hardware and software, hands-on application. Credit may be received for only one of C R P 434, FOR (E N R) 434.
- FOR 641 Properties of Wood Products 3(3,0)**
Basic properties of wood including the hygroscopic, thermal, electrical, mechanical, and chemical properties; standard testing procedures for wood. *Preq:* Junior standing or consent of instructor.
- FOR 642 Manufacture of Wood Products 3(3,0)**
Manufacture of lumber, plywood, poles, piles; drying, preservation, grading, and uses of wood products. Manufacture of particleboard, flakeboard, oriented-strand board, fiberboard, and paper products. Includes physical, mechanical, and chemical properties and their applications. *Preq:* Consent of instructor.
- FOR 644 Forest Products Marketing and International Trade 3(3,0)**
Study of marketing and international trade practices currently employed by the forest products industry and the application of basic marketing principles and global trade concepts in the industry's current and future environment. *Preq:* FOR 442 or consent of instructor.
- FOR 650 Woody Plant Stress Physiology 3(3,0)**
Structure, function, and physiology of tree shoot and crown growth, wood formation, diameter growth, root growth, and reproduction especially as related to stress factors. *Preq:* BIOSC 401 or FOR 460 or consent of instructor.
- FOR (EE&S, B E) 651 Newman Seminar and Lecture Series in Natural Resources Engineering 1(0,2)**
See B E 651.
- FOR 665 Silviculture 4(3,3)**
Discussion of the theory and practice of manipulating forests to meet the needs and values of landowners and society in accordances with biological, ecological, and economic principles. *Preq:* FOR 206 and Forestry Summer Camp or consent of instructor.
- FOR 707 Special Problems in Forestry 1-3(1-3,0)**
Directed individual study of a special problem in an applied field of forestry. Written report of study results is required.
- FOR 805 Forest Landscape Ecosystems 4(3,3)**
Three basic landscape components of soils, landform, and vegetation; their interrelationships in forest ecosystems; factors and processes of soils as interacting components with landform and vegetation. Offered fall semester of even-numbered years only. *Preq:* Graduate standing or consent of instructor.
- FOR 806 Advanced Silviculture—Forest Tree Growth and Development 3(3,0)**
Growth and development of economically important forest tree species; structure, function, phenology, and wood formation related under forest stand conditions emphasizing manipulation of forest tree growth by cultural practice; current research in growth and culture of forest trees and stands. Offered fall semester of odd-numbered years only. *Preq:* BIOSC 401, 402; or consent of instructor.
- FOR 807 Special Problems in Forestry 1-12**
Special problems in forestry research methods that do not directly pertain to the candidate's thesis.
- FOR 808 Seminar 1(1,0)**
Research and current developments in forestry. Students and staff participate. May be taken up to two semesters for credit. To be taken Pass/Fail only.
- FOR 811 Forest Wetland Ecology and Management 2(2,0)**
Assessment of ecological processes and how they influence forest wetland productivity, management, and regulation. Offered spring semester only. *Preq:* Introductory ecology or consent of instructor.
- FOR 812 Fire Ecology and Management 3(2,3)**
Historical presence of fire in various regions of North America and its effects on forests; analysis of current fire management strategies with emphasis on usage of prescribed fire as an ecosystem management tool. *Preq:* Graduate standing or consent of instructor.
- FOR 814 Advanced Forest Resource Management and Planning 3(3,0)**
Current forest resource management and planning topics; operational emphasis on application of various quantitative tools to solve economic and management problems; advanced topics in forest regulation, forest valuation, mathematical programming and harvest scheduling, simulation, multiple-use alternatives, and selected areas. Offered spring semester of odd-numbered years only. *Preq:* FOR 417 or consent of instructor.
- FOR 815 Systems Processes in Natural Resources 3(2,3)**
Use of system thinking and system analysis to define the issues, model, simulate, and evaluate alternatives for forest landscape problems and opportunities.
- FOR (PRTM) 816 Remote Sensing and GIS in Natural Resources 3(2,3)**
Practical application of computer mapping, spatial analysis, and natural resource inventory using remote sensing and geographical information systems. Offered spring semester of odd-numbered years only. *Preq:* FOR (E N R) 434 or consent of instructor.
- FOR 845 Biodiversity in Managed Forests 3(2,3)**
Theory and practice of maintaining biodiversity are fundamental to successful management of forests. Conservation of biodiversity is viewed from the macro (landscape) and micro (stand) levels. Socioeconomic and policy as well as ecological perspectives are considered in design of appropriate management practices. *Preq:* FOR 415, 460, or consent of instructor.
- FOR 891 Master's Thesis Research 1-12**
- FOR 893 Selected Topics in Forest Resources 1-4(0-4,0-12)**
Specialized topics not covered in other courses which explore current areas of research and management in forest and natural resources in a format of lecture, lab, or both. May be repeated for a maximum of eight credits, but only if different topics are covered. *Preq:* Graduate standing or consent of instructor.
- FOR 991 Doctoral Dissertation Research 1-12**
- ## FORESTRY AND NATURAL RESOURCES
- F N R 666 Stream Ecology 3(2,3)**
Covers the ecology of flowing water systems. Topics include geomorphology, physical and chemical factors of streams, biology of stream-dwelling organisms, trophic relationships, competition, colonization, drift, community structure, disturbance, and human impacts. *Preq:* Junior standing or consent of department chair.
- ## FRENCH
- FR 151 French for Graduate Students 3(3,0)**
Intensive program only for graduate students preparing for the reading examination in French. A minimum grade of B on final exam will satisfy Graduate School foreign language requirement. To be taken Pass/Fail only. May be repeated once for credit. *Preq:* Graduate standing.
- FR 699 Selected Topics in French Literature 3(3,0)**
Selected topics that have characterized French literature, language, and culture. May be repeated for a maximum of six credits. *Preq:* Consent of department chair.

GENETICS

GEN (BIOSC) 605 Molecular Genetics of Eukaryotes 3(3,0) Molecular genetic analyses of eukaryotes in relation to mutations and repair, complex phenotypes, biochemical pathways, short- and long-term regulation of gene expression, and evolution. *Preq:* GEN 302 or equivalent and one semester of biochemistry, or consent of instructor.

GEN 610 Fundamentals of Genetics I 3(3,0) First in a two-semester sequence in genetics covering Mendelian genetics, topics in cytogenetics, extranuclear inheritance, quantitative, evolutionary, conservation, and population genetics. *Preq:* CP SC 120 (or equivalent), EX ST 301, GEN 302, or consent of instructor.

GEN 611 Fundamentals of Genetics I Laboratory 1(0,3) Crosses are carried out using eukaryotic organisms (*C. elegans*, *Drosophila*, yeast) with appropriate markers to follow inheritance. Population and evolutionary genetics concepts are also examined. *Preq:* GEN 410 or concurrent enrollment.

GEN (BIOSC) 616 Recombinant DNA 3(3,0) Familiarizes students with the most current facts and concepts of molecular genetics. Lectures focus on gene organization, structure, and expression in prokaryotes and eukaryotes, highlighting current technologies and research in these areas. *Preq:* GEN 302 or equivalent and one semester of biochemistry or consent of instructor. A developmental biology course is also strongly recommended.

GEN (BIOSC, MICRO) 618 Biotechnology I: Nucleic Acids Techniques 4(2,4) Basic training in the manipulation of genetic information using recombinant DNA technology. Includes techniques in molecular cloning, Southern and Northern analyses, clone library construction. *Preq:* BIOCH 301 or 305, MICRO 305 or consent of instructor.

GEN 620 Fundamentals of Genetics II 3(3,0) Second in a two-semester sequence in genetics covering molecular genetics, gene expression, recombinant DNA technology, genomics, bioinformatics, proteomics, developmental, human, cancer, and behavioral genetics. *Preq:* GEN 410 or consent of instructor.

GEN (BIOCH) 640 Bioinformatics 3(3,0) Theory and application of computational technology to analysis of the genome, transcriptome, and proteome. *Preq:* CP SC 120 (or equivalent), GEN 302, 410, or consent of instructor.

GEN 650 Comparative Genetics 3(3,0) Outlines the genome structure, function, and evolution based on available complete genome sequences. Topics include evolution of multigene families, origin of eukaryotic organelles, molecular phylogeny, gene duplication, domain shuffling, transposition, and horizontal gene transfer. *Preq:* GEN 420 and 440, or consent of instructor.

GEN (BIOSC, HORT) 665 Plant Molecular Biology 3(3,0) See HORT 665.

GEN 670 Human Genetics 3(3,0) Basic principles of inheritance; population, molecular, and biochemical genetics; cytogenetics; immunogenetics; complex traits; cancer genetics; treatment of genetic disorders; genetic screening and counseling; and the Human Genome Project. *Preq:* GEN 302 or consent of instructor.

GEN (ENT) 695 Insect Biotechnology 3(3,0) See ENT 695.

GEN 730 Genetics Topics for Teachers 3(2,2) Lectures and laboratories focus on genetics and biotechnology. Restricted to elementary and secondary teachers. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

GEN 801 Cytogenetics 3(2,3) Classical and contemporary problems of chromosome structure, behavior, and transmission; recombination; interspecific hybridization; euchromatin and heterochromatin; polyploidy; mutable genetic systems; structural and numerical aberrations of chromosomes and their effects upon breeding systems of plants and animals. Offered spring semester of alternate years only. *Preq:* GEN 302 or equivalent.

GEN 803 Quantitative Genetics 3(3,0) Quantitative genetics concepts, line crosses and inbreeding, detecting major genes, mapping quantitative trait loci, estimation of genetic variation and heritability. Offered spring semester only. *Preq:* GEN 814 or consent of instructor. (EX ST 801 is recommended.)

GEN (BIOCH) 805 Issues in Research 2(2,0) See BIOCH 805.

GEN 806 Special Problems in Genetics 1-3 (0,3-9) Research not related to a thesis.

GEN (BIOCH) 810 Principles of Molecular Biology 3(3,0) See BIOCH 810.

GEN 812 Physiological Genetics 3(3,0) Advanced topics in the molecular aspects of physiological genetics including genes and metabolism, genes and signal transduction, oncogenes and growth, chromosomal aberrations, immunogenetics, and others. *Preq:* A semester of biochemistry and introductory genetics.

GEN 814 Advanced Genetics 3(3,0) Topics include organization of DNA in prokaryotes and eukaryotes, mutation, extranuclear inheritance, recombination, control of gene activity, systems of mating, genes and development, genetics of behavior, population genetics, genetics and disease. *Preq:* GEN 302 or equivalent, graduate enrollment in Genetics, or consent of instructor.

GEN 815 Developmental Genetics 3(3,0) Current research in developmental genetics including model systems, homeotic genes of *Drosophila*, primary induction, adhesion, molecules and cancer, axis formation, global pattern mutants in plants, homeobox genes in plants, and photo regulation. *Preq:* GEN 814 or consent of instructor.

GEN (BIOCH) 820 Genomics and Proteomics 3(3,0) Genomes, transcriptomes, and proteomes of a variety of organisms are studied along with the technology used to obtain them. Bioinformatics tools and access to this information are developed, and the significance of this information for the life sciences is made clear. *Preq:* BIOCH 814 or GEN 814 or consent of the instructor.

GEN (BIOCH) 825 Seminar I 1(1,0) Special topics and original research in genetics reviewed by students, faculty, and invited lecturers. May be repeated for credit. *Preq:* One semester of genetics.

GEN 830 Population Genetics 3(3,0) Topics include statistical methodology in the study of population genetics, probability as applied to genetic systems, gene and zygotic frequencies, derivation of genetics expectation, forces that change gene frequency, inbreeding, estimation, and testing of genetic parameters. *Preq:* GEN 814 or consent of instructor. (EX ST 801 is recommended.)

GEN (BIOCH) 851 Seminar II 1(1,0) See BIOCH 851.

GEN 890 Special Topics in Genetics 1-3(1-3,0) Group discussion of recent developments in genetic research. May be repeated for a maximum of six credit hours. *Preq:* GEN 302 and consent of instructor.

GEN 891 Master's Thesis Research 1-12

GEN 991 Doctoral Dissertation Research 1-12

GEOGRAPHY

GEOG 601 Studies in Geography 3(3,0) Intensive study of the geography of a selected world regions, such as North America, Europe, or the Middle East or the geography of a topic, such as the geography of oil or the geography of underdevelopment. May be repeated once for credit with departmental consent. *Preq:* GEOG 101 or 103 or consent of instructor.

GEOG 610 Geography of the American South 3(3,0) Study of geography of the American South in its changing complexities of almost 400 years of development. *Preq:* GEOG 101 or 103 or consent of instructor.

GEOG 620 Historical Geography of the United States 3(3,0) Survey that places the spatial concepts of geography into a time sequence with emphasis on the United States. *Preq:* GEOG 101 or 103 or consent of instructor.

GEOG (PRTM) 630 World Geography of Parks and Equivalent Reserves 3(3,0) See PRTM 630.

GEOG 640 Geography of Historic Preservation 3(3,0) Aspects of historic preservation with emphasis on sites and structures in their geographical, historical, and socioeconomic contexts. Examples are drawn from American architectural styles and settlement forms. *Preq:* GEOG 101 or 103 or consent of instructor.

GEOG 710 Teaching Geography 3(3,0) Investigates world regions as a set of problems posed to teachers of geography; comparative analysis of basic geographic concepts. Oriented to public school teachers of geography.

GEOLOGY

GEOL 603 Invertebrate Paleontology 3(2,3) Study of life of past geologic ages, as shown by fossilized remains of ancient animals, with emphasis on the invertebrates. *Preq:* GEOL 101 or consent of instructor.

GEOL 605 Surficial Geology 4(3,3) Study of surface features of the earth and the processes that produce them. Analysis of landforms including their form, nature, origin, development, and rates and patterns of change. Laboratory studies emphasize terrain analysis and the mechanics of surficial geological processes. *Preq:* GEOL 102, 300, or consent of instructor.

- GEOL 608 Geohydrology 3(3,0)** Study of the hydrologic cycle, aquifer characteristics, theory of groundwater movement, mechanics of well flow, experimental methods, and subsurface mapping. *Preq:* GEOL 101, 102.
- GEOL 613 Stratigraphy 3(2,2)** Analysis of stratified rocks as the repository of earth history and the conceptual framework used to synthesize the world geologic record as a coherent whole. Emphasis is placed not only on traditional lithostratigraphy but also on modern seismic stratigraphy, biostratigraphy, magnetostratigraphy, and current stratigraphic issues. *Preq:* GEOL 314 or consent of instructor.
- GEOL 615 Analysis of Geological Processes 3(3,0)** Introduction to methods for analyzing geological processes. Mathematical methods are introduced to solve problems related to stream flow, reaction kinetics, radioactive decay, heat flow, diffusion, fluid flow through geologic media and related processes. *Coreq:* MTHSC 206 or consent of instructor.
- GEOL 621 GIS Applications in Geology 3(1,4)** Introduction to geographic information systems with applications to current geological and hydrological problems. Topics include use of global positioning systems, spatial analysis, and image analysis. Hands-on training with GIS software and techniques is covered. *Preq:* Senior standing, strong computer skills.
- GEOL 651 Selected Topics in Hydrogeology 1-4(1-3,0-3)** Selected topics in hydrogeology, with emphasis on new developments in the field. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* GEOL 300 or 408 or consent of instructor.
- GEOL 659 Biogeochemistry 3(3,0)** Examines how biology directs mass and energy transfer between the lithosphere, biosphere, hydrosphere, and atmosphere. The scale of examination ranges from molecular to global. Topics include element cycling, mineral-microbe/plant interface, biomineralization, and biogeochemical applications to bioremediation, ecology, environmental toxicology, and biotechnology. *Preq:* CH 102 or GEOL 318 or consent of instructor.
- GEOL 790 Selected Topics in Earth Sciences 1-6(0-6,0-18)** One or more earth science topics. Lecture and laboratory emphasize the incorporation of new or updated subject matter into classroom instruction. Restricted to elementary and secondary school teachers. May be repeated for credit, but only if different topics are covered.
- GEOL 800 Groundwater Geochemistry 3(2,3)** Lectures and project-oriented field work focusing on processes controlling natural impurities in groundwater and the occurrence of inorganic, organic, and radioactive contaminants; solution equilibria, chemical weathering, oxidation-reduction, utilization of radioactive isotopes as tracers and studies of contamination plumes. *Preq:* CH 102 or equivalent.
- GEOL 801 Field Geophysics Techniques and Interpretation 3(2,3)** Project-oriented field study of basic geophysical methods used for shallow geological investigations and for environmental site characterization; seismic, electrical, and electromagnetic sounding, ground-penetrating radar, magnetics, gravity, self-potentials, and borehole geophysics. Emphasis is on basic principles and physical understanding of the geophysical methods with applications in mind. *Preq:* Consent of instructor.
- GEOL 803 Geostatistics 3(3,0)** Numerical and statistical treatment of geological data emphasizing the analysis of spatially and temporally distributed variables and unique aspects of geological variables; methods of sampling geological data, quantitative procedures for reducing the dimensionality of geological data sets, and techniques for presentation and interpretation of results. *Preq:* EX ST 301 or MTHSC 301.
- GEOL 805 Advanced Stratigraphy 3(3,0)** Classification, distribution, chronologic succession, and correlation of sedimentary rocks; interpretation of features of strata in terms of their origin, depositional environment, paleogeography, and relation to organic evolution; Atlantic Coastal Plain stratigraphy. *Preq:* GEOL 413 or consent of instructor.
- GEOL 806 Aquifer Characterization 3(3,0)** Characterization of aquifers from the microscopic scale to the regional scale; geological origin of aquifers and modification by diagenetic and deformational processes; application of subsurface geological techniques to data acquisition and interpretation; prediction of fluid occurrence and flow by integrating results of subsurface analysis.
- GEOL 807 Tectonics 3(3,0)** Deformation processes and features of the Earth's crust at the regional to global scale; characteristic structures of active rift, transform and convergent margins; origin of mountain belts and sedimentary basins within a plate-tectonic framework. *Preq:* GEOL 302 or consent of instructor.
- GEOL (EE&S) 808 Groundwater Modeling 3(3,0)** Mathematical and computer modeling of groundwater flow and nonreactive solute transport through geological formations; conceptual flow-models for geologic systems; formulation of governing mass and energy conservation equations; application of analytical, numerical, and stochastic models to real-world problems. *Preq:* Consent of instructor.
- GEOL (EE&S) 809 Subsurface Remediation Modeling 3(3,0)** Lectures and computer exercises involving subsurface remediation methods including groundwater extraction, soil vapor extraction, stream flooding, and a variety of other techniques; modeling flow of multiphase and multicomponent mixtures in porous medium. *Preq:* GEOL (EE&S) 808 or consent of instructor.
- GEOL (EE&S) 810 Analytical Methods for Hydrogeology 3(3,0)** Analytical mathematical methods for modeling subsurface fluid flow and transport processes including saturated water flow, unsaturated zone gas flow, chemical transport, and heat transfer, emphasizing the derivation and solution of governing equations for modeling subsurface flow and transport. *Preq:* GEOL (EE&S) 808 or graduate-level groundwater course or consent of instructor.
- GEOL 811 Rock Physics 3(3,0)** Experimental and theoretical rock physics; electrical, fluid-transport and seismic properties; rock/solution interface and how that interface affects electrical, fluid transport, and seismic properties; magnetic, mechanical, and thermal responses. *Preq:* Consent of instructor.
- GEOL 813 Environmental Geochemistry 3(3,0)** Inorganic geochemistry, specifically the distribution of trace elements in rocks, regolith, and water. Topics include micronutrients and concepts of essentiality; health problems related to natural occurrence of toxic elements; environmental pollution arising from nonferrous metal mining, coal mining and coal use, and gasoline additives; urban and regional geochemistry. *Preq:* GEOL 318 or consent of instructor.
- GEOL 814 Environmental Sedimentology 3(3,0)** Environmental-based applications of sedimentology to developing an understanding of heterogeneity and scale, fluid flow and saturation, sediment-fluid interactions, and modeling approaches; field and laboratory methods; case studies; implications to environmental sustainability. *Preq:* Consent of instructor.
- GEOL 816 Aquifer Systems 3(3,0)** Hydrogeologic characteristics of selected major aquifer systems in the U.S. and elsewhere; conceptual models for the controls of recharge, discharge, and flow-through aquifers in different geologic settings; development of numeric models to simulate natural and stressed aquifers. *Preq:* GEOL 408 and (EE&S) 808 or consent of instructor.
- GEOL 818 Hydrogeology of Fractured Aquifers 3(3,0)** Processes and characteristics of fluid flow through naturally and artificially fractured subsurface formations; principles of flow in dual porosity materials, characterizing fractures and fractured aquifers, mechanics of fracture formation, methods of inducing fractures from wells; case studies and applications. *Preq:* GEOL 408 and (EE&S) 808 or consent of instructor.
- GEOL 850 Selected Topics in Environmental Geology 1-4(1-3,0-3)** Selected topics in environmental geology emphasizing the subsurface contamination. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.
- GEOL 851 Geology Seminar 1(1,0)** Students review current topics in geology and make oral presentations. May be taken twice for credit.
- GEOL 875 Hydrogeology Summer Field Camp 6(4,6)** Groundwater geology field techniques including examination of surface exposures, analysis of cores and geophysical well logs, subsurface mapping, aquifer performance test, and groundwater remediation. *Preq:* Consent of instructor.
- GEOL 891 Master's Thesis Research 1-12**

GERMAN

- GER 151 German for Graduate Students 3(3,0)**
Intensive program only for graduate students preparing for the reading examination in German. Minimum grade of B on final exam will satisfy Graduate School foreign language requirement. To be taken Pass/Fail only. May be repeated once for credit. *Preq:* Graduate standing.
- GER 698 Independent Study 1-3(1-3,0)** Selected topics in German literature, language, or culture. May be repeated for a maximum of six credits. *Preq:* Consent of department chair.

GRADUATE STUDIES

- G S 799 Comprehensive Studies 1-15(1-15,0)**
Independent studies in preparation for comprehensive examinations; credit hours to be determined by the department or program chair. To be taken Pass/Fail only.
- G S 800 Research Proposal Development Seminar 1(1,0)** Principles and techniques for the preparation of research proposals. Does not count toward a graduate degree. To be taken Pass/Fail only. *Preq:* Second year or graduate standing in current major.

GRAPHIC COMMUNICATIONS

- G C 605 Package and Specialty Printing 2(2,0)**
Problems and processes for printing and converting in package, label, and specialty printing industries. Flexographic preparation, printing, die making, diecutting, transfer printing, screen container printing, pad printing, and bar code production are covered. New developments and trends are discussed. *Preq:* G C 165, 310, 350; concurrent enrollment in G C 606; or consent of instructor.
- G C 606 Package and Specialty Printing Laboratory 2(0,6)** Laboratory in techniques for printing and converting in package, label, and specialty printing industries. Experiences in flexographic prepress; printing; die design, die making, and die cutting for label, folding cartons, and corrugated; and glass, plastic, and metal container printing. *Preq:* G C 165, 310, 350; concurrent enrollment in G C 605; or consent of instructor.
- G C 607 Advanced Flexographic Methods 4(2,6)** In-depth study of the methods used in flexographic printing and converting porous and nonporous substrates. Theory and laboratory applications include setting standards for process color, preparation of plate systems, ink mixing and color matching, testing of films and foils, analysis of recent developments, and prediction of future markets. *Preq:* G C 606 or consent of instructor.
- G C 640 Commercial Printing 5(2,9)** Advances skills learned in previous graphic communications courses and applies the knowledge to large format presses. Students work from the design conception stage through all aspects of preparation, production, and finishing. Emphasis is on understanding and incorporating emerging technologies into the production workflow. *Preq:* G C 310 and 350 or consent of instructor.
- G C 644 Current Developments and Trends in Graphic Communications 4(2,6)** Advanced course for Graphic Communications majors. Emphasis is on the theory and technical developments that affect process and equipment selection. Topics include color theory and application, electronic color scanning, electronic prepress and communications, gravure color quality control and analysis. *Preq:* G C 605, 606, 640.
- G C 645 Advanced Screen Printing Methods 3(2,3)** Systems and materials used in the screen printing process emphasizing techniques of control and procedures for establishing screen printing methods and standards. *Preq:* G C 207 or consent of instructor.
- G C 646 Ink and Substrates 3(2,3)** Covers components, manufacturing, process use, and end use of ink and substrates used in lithography, flexography, gravure, and screen printing. Examines the interrelationship among inks, substrates, and the printing process. Through controlled testing and examination, the optimum conditions for improved printability are determined. *Preq:* G C 605; 606 or 640; or consent of instructor.
- G C 648 Planning and Controlling Printing Functions 3(2,3)** Study of systems for setting printing production standards, estimating, scheduling, job planning, and the selection of new hardware and technologies. *Preq:* G C 350, 450, 605, 606, 640, or consent of instructor.
- G C 690 Graphic Communications Selected Topics 1-3(1-3,0)** Subjects not covered in other graphic communications courses; organized according to industry trends and student needs. May be repeated for a maximum of 18 credits, but only if different topics are covered. *Preq:* Consent of instructor.
- G C 801 Process Control in Color Reproduction 3(2,3)** Techniques and rationale for procedures used in reproducing color originals for printed media. Topics include color systems, measurement, reproduction characteristics, proofing systems, process evaluation/analysis for offset, gravure, flexographic, and screen printing processes. *Preq:* G C 644 or equivalent.
- G C 811 Printing Industry Operations 3(2,3)** Concepts and principles of operations and applications of technology and trends within the printing, publishing, packaging, and allied industries. Twelve plant visits supplement study of the organization, management, marketing, economics, production, environmental issues, and products of modern graphic communications firms.
- G C 831 Color Science Applied to Graphic Communications 3(2,3)** Color reproduction applications found in both photomechanical and digital workflows for print production; foundation in color science principles, measurement, and integration relative to the printing, publishing, and packaging industry; color systems development, application, and integration. *Preq:* Consent of instructor.
- G C 850 Graphic Communications Internship 1(1,0)** Full-time employment for hands-on experiences in manufacturing, marketing, or managing within the graphic communications industry. For Graphic Communications graduate students only. May be repeated for a maximum of two credits. *Preq:* G C 310 or equivalent and consent of instructor.

- G C 891 Master's Thesis Research 1-6(1-6,0)**
Student participation in a research project. Basic skills in a selected research methodology are developed. *Preq:* G C 894.
- G C 894 Graphic Communications Graduate Seminar 1(1,0)** Discussions on relevant topics and guidance to prepare research proposals in the graphic communications field. May be repeated for a maximum of two credits, but only if different topics are covered. *Preq:* Graduate standing and consent of instructor.
- G C 897 Graphic Communications Research Problems I 3(3,0)** In-depth investigation of phenomena relative to the printing, publishing, packaging, or allied industries. *Preq:* G C 894, acceptance of a written proposal, approval of advisor.
- G C 898 Graphic Communications Research Problems II 3(3,0)** Continuation of G C 897. In-depth investigation of phenomena relative to the printing, publishing, packaging, or allied industries. *Preq:* G C 894, 897, acceptance of a written proposal, approval of advisor.

HEALTH

- HLTH 600 Selected Topics in Health 1-3(1-3,0)**
Topics selected to meet special and individualized interest of students in health. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Junior standing, consent of instructor.
- HLTH 601 Health Consumerism 3(3,0)** Exploration of consumer decisions regarding health products and services with emphasis on strategies for decision making. Health majors and minors will be given enrollment priority. *Preq:* Two-semester sequence in science or consent of instructor.
- HLTH 610 Maternal and Child Health 3(3,0)**
Focuses on key issues concerning the health status and needs of mothers and children. Topics include primary health care, measurement and indicators of health status, health of minorities, role of families, and major programmatic interventions towards the health needs of these two groups.
- HLTH 615 Public Health Issues in Obesity and Eating Disorders 3(3,0)** In-depth review of prevalence, risk factors, consequences, and treatments of obesity and other eating disorders. Focuses on the public health importance of cultural norms, prevention, and early intervention as it relates to obesity and eating disorders. *Preq:* Junior standing in Health Science or consent of instructor.
- HLTH 620 Health Science Internship 1-6(0,3-18)** Under supervision in an approved agency, students have an opportunity for on-the-job experiences. Students are placed in an agency and develop personal/professional goals and objectives appropriate to the setting, population, and health issues. Students create a comprehensive exit portfolio in a digital format. *Preq:* HLTH 419, minimum grade-point ratio of 2.0, Junior standing in Health Science, consent of instructor.
- HLTH 630 Health Promotion of the Aged 3(3,0)**
Focuses on analysis and evaluation of health issues and health problems of the aged. Emphasis is on concepts of positive health behaviors. Health majors and minors will be given enrollment priority. *Preq:* Developmental psychology; a two-semester sequence in science; or consent of instructor.

HLTH 650 Applied Health Strategies 3(3,0)

Students plan, implement, and evaluate strategies to promote health through individual behavior changes. Both healthful and unhealthful behaviors are included. Examples include smoking cessation, weight management, and stress management. *Preq:* HLTH 480, Health Science major.

HLTH 698 Improving Population Health 3(3,0)

Critical examination of current and emerging issues in improving public health practice and population health. Covers examples in empirical and applied research, revealing future trends in population health. Health majors and minors will be given enrollment priority. *Preq:* HLTH 240, 298, 380, or consent of instructor.

HLTH 802 Health Economics 3(3,0)

Provides in-depth exposure to economic concepts and theory as applied to the health services sector. Topics include health-care demand and supply analysis, consumer behavior, production and costs, perfect competition vs. health-care competition, price discrimination, and regulation. *Preq:* Undergraduate course in principles of economics.

HLTH (MICRO) 809 Epidemiological Research 3(3,0)

See MICRO 809.

HLTH 810 Health Policy 3(3,0)

Provides experience in analysis of decisions in health-care management policy, problems, resources, and alternative courses of action for health service organizations. Students participate in analysis of organization objectives and means for achieving health service goals. *Preq:* HLTH 807 or M B A (FIN) 807, M B A 803, 806, 808, MGT (M B A) 809 or equivalent.

HEALTH ADMINISTRATION**M H A 717 Selected Topics in Health Administration 1-3(1-3,0)**

Variable topics are taught to reflect current state-of-the-art issues. May be repeated for a maximum of six credits, but only if different topics are covered.

M H A 719 Health Care Management 3(3,0)

Focuses on the structure and function of the well managed and appropriately led acute care hospital. Other health service organizations are also considered, and general management and operations theory are discussed.

M H A 721 Health Care Delivery Systems 3(3,0)

Overview of the development of the health services delivery system in the United States.

M H A 722 Health Behavior and Epidemiology 2(2,0)

Focuses on understanding the health behavior of a population and individuals. Introduces the concept of the health status of a population and discusses both methods of measurement and sources of data.

M H A 724 Health Care Ethics 3(3,0)

Examination and analysis of the professional standards, laws, and political and economic forces that establish a context for health care ethics.

M H A 732 Outcomes Assessment and Evaluation in Health Services 3(3,0)

Introduces the general application of evaluative research in a variety of health care settings, administrative purposes of evaluation of organizational components and/or programs, and the design and implementation of evaluative efforts.

M H A 735 Health Law and Risk Management 2(2,0)

Introduces legal concepts and issues related to health care management.

M H A 741 Seminar in Community and Rural Health 3(3,0)

Introduces community health planning concepts and explores methods and the unique aspects of rural health among the population residing there.

M H A 743 Managing with Health Professionals 3(3,0)

Devoted to learning about clinical professionals and exploring ways to facilitate effective and efficient team relationships in the management and delivery of health services.

M H A 752 Health Administration Field Project 3(3,0)

Provides an opportunity to apply principles, theories, and concepts to a well-defined problem or issue currently confronting the health service administrator.

M H A 853 Seminar in Health Administration and Leadership 2(2,0)

Integrates knowledge and skills acquired across all courses in the context of strategic management.

HEALTH, EDUCATION, AND HUMAN DEVELOPMENT**HEHD 610 Leadership Behavior and Civic Engagement 3(2,1)**

Students couple concepts of social justice and civic engagement with theoretical foundations from HEHD 400 to complete a comprehensive theory-to-practice project. Introduces students to a comprehensive leadership skill set to become active change agents for the common good. *Preq:* HEHD 400.

HEHD 620 Leadership Application and Experience 3(2,3)

Immerses students in a practical leadership experience utilizing knowledge and skills gained in HEHD 400 and 410. Students identify an issue or problem and practice leadership by developing and implementing a community project. Challenges students to commit themselves to long-term engagement as agents of change. *Preq:* HEHE 410.

HEHD 800 Theories of Youth Development: An Applied Perspective 3(3,0)

Examines theories of positive youth development with an emphasis on how to apply them to "real world" issues facing young people. Students explore existing models, read theoretical and applied literature, and examine current social changes that impact positive youth development.

HEHD 801 Child and Adolescent Development 3(3,0)

Focuses on child and adolescent development emphasizing a strength-based approach. Students develop an understanding of early childhood and adolescent growth and development from a social, cultural, and psychological perspective.

HEHD 802 Youth Development Programming in a Contemporary Society 3(3,0)

Focuses on programs and administrative policies and procedures that govern youth development programs at the local, state, and national levels. Model programs emphasizing "best practices" are studied. A cross-sectional approach is used to examine assets and protective factors in the contexts of family, school, and community.

HEHD 803 Creative and Ethical Leadership in a Changing Society 3(3,0)

Focuses on the development of leadership skills and group dynamics in program development and supervision of staff and volunteers. Students engage in listening, empowerment, and process skills utilizing the latest approaches in the field of communications. Professional ethics related to human service professionals are integrated.

HEHD 804 Assessment and Evaluation of Youth Programs 3(3,0)

Focuses on developing knowledge of rationale, procedures, and tools for conducting intake, needs, and environmental assessments of youth, families, and communities. Effective skills for mastering comprehensive program evaluation strategies are taught. Students explore statistical packages specifically appropriate for evaluation of youth programs.

HEHD 805 Youth Development in the Context of Family 3(3,0)

Focuses on youth development in the context of family development and interpersonal relationships. Students gain knowledge and skills in development issues and family functioning. Students become aware of and respect diverse family structures, parental involvement, and the influence of culture and ethnicity on family dynamics.

HEHD 806 Youth Development in the Context of a Global and Diverse Society 3(3,0)

Focuses on specific circumstances and issues related to youth in at-risk environments. Students learn methods, strategies, and techniques to address diversity issues (i.e. racial, ethnic, gender, disability, sexual preference). Issues of poverty, mass culture, physical environment, etc. are examined globally.

HEHD 807 Internship in Youth Development 3(0,9)

Practical experience in youth-serving agencies/organizations. Students are required to complete a minimum of 150 hours of experiential education in a supervised setting. Upon approval, exceptions are given to students with experience working in youth-related fields. To be taken Pass/Fail only. *Preq:* Consent of program coordinator.

HEHD 808 Grantsmanship 3(3,0)

Students conduct searches to identify youth-related funding sources. They write proposals to include purpose, rationale, background information, literature review, identification of collaborators/partners, budget, budget justification, and human subjects review. *Preq:* Admission to MS in Youth Development Leadership Program.

HEHD 809 Management of Staff and Volunteers 3(3,0)

Examines approaches and strategies for successful management and development of staff and volunteers in youth-serving organizations, including effective organizational systems and working with boards and advisory committees. Covers business and organizational principles and practices for success as well as challenges of recruiting, supervising, and retaining staff and volunteers. *Preq:* Youth Development Leadership major or consent of instructor.

HEHD 892 Master's Project 3(0,9)

Students conduct evaluative research projects to include writing an article for submission to a professional journal. Students present articles to instructor for review. To be taken Pass/Fail only. *Preq:* Consent of program coordinator.

HISTORIC PRESERVATION

H P 610 History and Theory of Historic Preservation 3(3,0) Survey history of preservation that explores a variety of theoretical issues that impact the discipline. Provides a basis for critical evaluation of historic preservation. *Preq:* Three semesters of Art and Architectural History or equivalent or consent of instructor.

H P 611 Research and Documentation in Historic Preservation 3(3,0) Introduction to documenting and recording historic buildings and landscapes. Charleston and its environs provide case study projects for archival research, field investigation, and preparation of final documentation. *Preq:* Three semesters of Art and Architectural History or equivalent or consent of instructor.

H P 612 Materials and Methods of Historic Construction 3(3,0) Survey of traditional materials and methods of construction in America from the 18th through the early 20th century. Scientific examination of historic construction provides case studies. *Preq:* Three semesters of Art and Architectural History or equivalent or consent of instructor.

H P 800 Historic Preservation Internship 1-3(1-6, 3-18) Six credits of approved internship in Historic Preservation are required during the course of the graduate program and can be completed in one summer of the program. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* Consent of supervising faculty.

H P 801 Legal and Economic Issues in Historic Preservation 3(3,0) Examines historic preservation against the backdrop of contemporary legal and economic issues. *Preq:* ARCH 405, H P 410, 411, 412; or consent of instructor.

H P 802 Historic Preservation Research Seminar 3(3,0) Advanced documentation and analysis of historic resources in preparation for thesis project. *Preq:* H P 801, 805.

H P 803 Advanced Materials and Methods in Conservation 3(3,0) Advanced study of historic building materials and conservation techniques. *Preq:* H P 805. *Coreq:* H P 810.

H P 804 Management and Administration of Historic Preservation 3(3,0) Praxis on the management of historic properties with emphasis on administering a preservation project in the field and establishing a maintenance program for a historic property. *Preq:* H P 810.

H P 805 Preservation Studio 6(0,18) Examines Charleston and its environs through the development of a comprehensive preservation project for a specific site. *Preq:* ARCH 405, H P 410, 411, 412. *Coreq:* H P 801.

H P 806 Society and Culture of Early Charleston 3(3,0) Examines the society and culture of early Charleston (c. 1670–1861) through a localized analysis of important topics in American social/cultural history. Topical study is applied to an investigation of extant Charleston buildings and urban fabric. *Preq:* H P 610 or consent of instructor.

H P 810 Conservation Lab in Historic Preservation 6(0,18) Conservation of historic materials on site and in the lab. *Preq:* H P 805. *Coreq:* H P 803.

HP 811 Readings in Historic Preservation 3(3,0) Critical overview of the history, development, and current practice of historic preservation focusing on the United States. Topics include American and European perspectives; the development of preservation as a profession; current theory and practice; and the use, abuse, and fetishization of history. *Preq:* Enrollment in MS or certificate program in Historic Preservation.

H P 819 Investigation, Documentation, and Conservation 3(3,0) Through study and application of the Historic American Buildings Survey, the standard method for creating baseline documents, students gain experience in the best investigation and documentation techniques. The method is applied to various structures located in Charleston's historic district. Students also gain a base understanding of conservation practices and techniques.

H P 823 Historic Interiors 3(3,0) Students gain familiarity with American interiors and decorative arts from early European settlement through the late 19th century. They consider periodization and documentation of the structure, finishes, decorations, and the material culture of those structures with emphasis on the interpretation of primary documents: inventories, pattern books, accounts, paintings, and prints.

HP 833 Cultural and Historic Landscape Preservation 3(3,0) Overview of cultural historic landscape preservation principles and practices. Includes inventory and analysis of historic resources from a cultural landscape perspective. Qualities of integrity are studied in correspondence to location, design, setting, materials, workmanship, and feeling and association. *Preq:* Enrollment in MS in Historic Preservation program or consent of instructor.

H P 859 Professional Project in Historic Preservation 3(3,0) Professional project is a thesis alternative that provides students with a more flexible presentation of their research to reflect essential preservation knowledge and skills. Students work directly with their committees to complete projects requiring a flexible presentation such as documentation drawings and other methods germane to historic preservation. *Preq:* Consent of advisor.

H P 890 Directed Studies 1-6(1-6,0) Special topics and independent research in historic preservation with faculty guidance. May be repeated for a maximum of six credits. *Preq:* Consent of advisor.

H P 891 Thesis Research 1-6 Thesis proposals are defended in the third semester and completed as a multimedia project in the fourth semester of the program. Projects using the historic resources of Charleston and its environs, or other suitable historic sites, are encouraged. To be taken Pass/Fail only. *Preq:* H P 802, 810.

HISTORY

HIST 600 Studies in United States History 3(3,0) Topics and problems in the history of the United States from the Colonial era to the present.

HIST 620 History and Film 3(2,3) Analyzes the role of the cinema in the construction and dissemination of history.

HIST 624 Topics in History of Medicine and Health 3(3,0) Selected topics in the development of medicine and health care including public attitudes towards health and medicine.

HIST 636 The Vietnam Wars 3(3,0) Wars in Vietnam are seen in two phases. The First Indochina War, 1946–54, is covered briefly. Main body of the course covers the Second Indochina War, which began as a guerrilla conflict in 1959–60 and ended as a mostly conventional war in the Communist victory of 1975.

HIST 638 Problems in African Historiography and Methodology 3(3,0) Concentrates on major issues in the field of African history with an additional focus on methodological concerns.

HIST 640 Studies in Latin American History 3(3,0) Consideration of selected and varied topics in Latin American history through readings, class discussions, and individual or group projects. Special attention is given to the use of an inquiry or problem-solving method of historical analysis and to the cultivation of a comparative perspective.

HIST 650 Studies in Ancient History 3(3,0) Selected topics in ancient history ranging from pre-Biblical times to the fall of the Roman Empire. May be repeated once for credit with departmental consent.

HIST 651 Alexander the Great 3(3,0) Focuses on the career of Alexander the Great and deals with the history and archaeology of ancient Macedonia.

HIST 660 Studies in British History 3(3,0) Examination of selected themes, topics, or periods in British history from Anglo-Saxon times to the present.

HIST 670 Studies in Early European History 3(3,0) Studies of selected topics or themes in European history from the fall of the Roman Empire to the age of industrialization.

HIST 671 Studies in Modern European History 3(3,0) Study of selected topics or problems in European history from the end of the Old Regime to the present.

HIST 691 Studies in the History of Science and Technology 3(3,0) Selected topics in the development of science and technology, with emphasis on their social, political, and economic effects.

HIST 692 Studies in Diplomatic History 3(3,0) Selected topics and problems in international conflict and conflict resolution among nations. Concentration is usually on 20th century history.

HIST 693 Studies in Social History 3(3,0) Studies in the ways people have earned their livings and lived their lives, individually and as communities, in the confines of different societies.

HIST 694 Studies in Comparative History 3(3,0) Selected topics in comparative history, contrasting and comparing similar historic developments in different nations, geographic areas, or civilizations.

- HIST 695 Studies in the History of Ideas 3(3,0)**
Selected topics and themes in the development of ideas that have had an impact on the behavior of individuals and civilizations.
- HIST 696 Studies in Legal History 3(3,0)**
Selected problems in the development of law and the system of criminal and civil justice.
- HIST 710 United States Since 1865 3(3,0)**
Problems in U.S. history since 1865 with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with consent of graduate program director.
- HIST 775 Europe Since the 18th Century 3(3,0)**
Problems in European history since 1700 with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with consent of graduate program director.
- HIST 800 Seminar in United States History 3(3,0)**
Training in historical research and writing. May be repeated for credit with consent of graduate program director.
- HIST 810 Culture and Society 3(3,0)**
Training in historical research and writing with a focus on the social and cultural underpinnings of U.S. history. May be repeated for credit as topics change with consent of graduate program director.
- HIST 820 American Historiography 3(3,0)**
Graduate seminar designed to familiarize students with the major overarching themes, scholarly interpretations, and issues of American history that historians have presented over the last century.
- HIST 830 Seminar in Asian History 3(3,0)**
Training in historical research and writing with focus on Asian history. May be repeated for credit with consent of graduate program director.
- HIST 840 Seminar in Latin American History 3(3,0)**
Training in historical research and writing with focus on Latin American history. May be repeated for credit with consent of graduate program director.
- HIST 860 Seminar in British History 3(3,0)**
Training in historical research and writing with focus on British history. May be repeated for credit with consent of graduate program director.
- HIST 870 Seminar in European History 3(3,0)**
Training in historical research and writing with focus on European history. May be repeated for credit with consent of graduate program director.
- HIST 872 Issues and Methods in European and Non-Western History 3(3,0)**
Seminar discussion of contemporary approaches to European and non-Western history; exploration of theoretical and empirical debates.
- HIST 880 Special Topics in History 3(3,0)**
Training in historical research and writing. May be repeated for credit with consent of graduate program director.
- HIST 881 Historiography 3(3,0)**
Seminar discussion of contemporary approaches and methodologies used by historians; exploration of current debates over major issues confronting the discipline of history.
- HIST 885 Independent Study 3(3,0)**
Critical study of a historical topic, selected according to needs of the student and with approval of graduate program director. May be repeated for credit with consent of graduate program director.
- HIST 887 Archival Management: An Introduction 3(3,0)**
Introduction to basic concepts of archival theory and management.
- HIST 890 Thesis Prospectus Workshop 1(1,0)**
Workshop to help students prepare for writing their master's thesis by producing a prospectus that includes historiographical argumentation and sources.
- HIST 891 Master's Thesis Research 1-12**
- HIST 893 Practicum in Archival Management 3(0,9)**
Hands-on experience in the operations of an archival program, including acquisitions, arrangements, descriptions, conservation, and reference service. *Preq:* HIST 887 or consent of instructor.
- HIST 894 Practicum in Historical Editing 3(3,0)**
Practicum for applying methodologies learned in introductory editing course to a specific body of original sources such as family correspondence, diaries, or journals in order to become a historical editor.

HORTICULTURE

- HORT 606 Nursery Technology 3(2,3)**
Principles and techniques in handling nursery crops. Offered spring semester only. *Preq:* HORT 303, 305.
- HORT 612 Advanced Turfgrass Management 3(2,3)**
Advanced principles and practices associated with turfgrass management for golf courses, sports fields, sod production, and commercial lawn care. Topics include turfgrass physiology, plant growth and development, construction, turfgrass nutrition, irrigation, drainage, pesticide use and fate, and development of effective management systems. *Preq:* CSENV 202, HORT 212, or consent of instructor.
- HORT 620 Applied Turfgrass Physiology 3(3,0)**
Advanced course in turfgrass science and management. Provides the current status and development of turfgrass stress physiology and research. Main topics include temperature, drought, traffic, edaphic stresses, new developments in the turf industry, and environmental stewardship. *Preq:* HORT 212, 213.
- HORT (FOR) 627 Urban Tree Care 3(3,0)**
See FOR 627.
- HORT (CSENV) 633 Landscape and Turf Weed Management 3(2,2)**
Weed management strategies that include cultural, biological, and chemical methods are studied for landscape and turfgrass areas. Problem-solving skills and herbicide characteristics are emphasized. *Preq:* HORT 212 or consent of instructor.
- HORT 655 Just Fruit 3(3,0)**
Students explore the origins, biology, culture, and production of major temperate zone fruits—apples, berries, and cherries to pawpaws, peaches, and pomegranates, the familiar to the forbidden. They discover principles, practices, and technologies employed to grow, protect, and harvest the fruits that feed us from commercial orchards, organic farms, and backyards. *Preq:* HORT 101 or consent of instructor.
- HORT 656 Vegetable Crops 3(3,0)**
Principles and practices employed in the commercial growing and marketing of vegetable crops with emphasis on plant characteristics, cultivars, management practices, harvest, quality factors and grading, storage, economic importance, and areas of production.
- HORT 661 Problems in Landscape Design 4(3,3)**
Landscape planning for larger residential properties, schools, industrial plants, real estate developments; detailed finished plans; further study of materials used; original problems; field study. Offered spring semester only. *Preq:* HORT 308 or consent of instructor.
- HORT (BIOSC, GEN) 665 Plant Molecular Biology 3(3,0)**
Study of fundamental plant processes at both the cellular and molecular levels including genome structure and organization (both nuclear and organellar); regulation of gene expression and its role in cellular and whole-plant processes; transposable genetic elements; applications for biotechnology. *Preq:* Junior standing or consent of instructor, BIOSC 304 or 305; GEN 302.
- HORT 671 Advanced Internship 1-6(0,2-12)**
Preplanned work experience under competent supervision in approved agency dealing with horticultural endeavors. Gives advanced students on-the-job learning opportunities to apply acquired knowledge and skills. Monthly reports and final departmental seminar required. Undergraduates may accumulate a maximum of six credits for participation in HORT 271 and/or 471. *Preq:* Junior standing and consent of instructor.
- HORT 672 Garden Experiences in Youth Development 2(1,3)**
Exploration of the role of gardening and related outdoor experiences in enhancement of educational development, self-esteem, and pro-social behavior in elementary school children. *Preq:* Senior standing and consent of instructor.
- HORT 701 Horticulture: Plant and Environmental Science 3(2,3)**
Scope of South Carolina horticulture and how it affects the quality of life economically and aesthetically; environmental responsibilities; methods of teaching plant principles. Three-day statewide field trip to horticultural industries is included. Not to be taken for credit by graduate students in Horticulture. Offered summer session only.
- HORT 812 Special Problems in Horticulture 1-4(1-4,0)**
Research not related to a thesis. May be repeated for a maximum of four credits. *Preq:* Consent of instructor.
- HORT 814 Environmental Plant Stress Physiology 3(2,2)**
Environmental stresses associated with water (drought, waterlogging), temperature, light, and air pollution with quantitative treatment of stress effects on plants; mechanisms by which plants may avoid, tolerate, or modify stress effects on plant growth and function at the molecular, cellular, and whole-plant levels. Offered fall semester only. *Preq:* BIOSC 401 and 402 or consent of instructor.

HUMAN RESOURCE DEVELOPMENT

H R D 820 Human Performance Improvement 3(3,0) Theory and practice of both instructional and noninstructional interventions and techniques used to improve human performance in the workplace. Covers fundamentals of human performance improvement, general processes of human performance improvement, and human performance interventions of a noninstructional nature.

H R D 825 Organizational Performance Improvement 3(3,0) Provides concepts and skills employed by managers and change agents to promote and sustain productive organizations. Students learn how to perform behavior analysis and management, how to determine criteria for performance appraisals, and how to establish leadership in the workplace. *Preq:* H R D 820, 830.

H R D 830 Concepts of Human Resource Development 3(3,0) Theory and practice of contemporary applications of human resource development (HRD) programs; training and development functions; strategies for designing and developing programs; and application of methods, techniques, and resources in the context of changing needs, technologies, demographics, and economic circumstances that create the need for different skills and knowledge in the work force. *Preq:* Consent of instructor.

H R D (CTE) 845 Needs Assessment for Education and Industry 3(3,0) Theory and practice of needs assessment activities in human resource development (HRD) programs; importance of the process to the identification of content/curricula topics and the overall training environment; specific methodologies used in the needs assessment process; supportive components of various program planning systems. *Preq:* H R D 830 or consent of instructor.

H R D (CTE) 846 Applied Public Relations 3(3,0) Practical and theoretical approaches to problem identification and the development of respective solutions in the public relations process; action and message generation, media development and evaluation of public relations techniques in existing organizations. *Preq:* Employment or ready access to an employer and place of employment; CTE 468 or 668 is desirable.

H R D (CTE) 847 Instructional Systems Design 3(3,0) Theory and practice of instructional systems development activities in human resource development (HRD) programs; identification, selection, and organization of subject matter appropriate for competency-based training (CBT) programs; occupational analysis techniques; rationale statements, goals, and objectives; related instructional materials; participant evaluation; and instructional scheduling. *Preq:* H R D (CTE) 845 or consent of instructor.

H R D 849 Evaluation of Training and Development/HRD Programs 3(3,0) Theory and practice of evaluation processes related to training and development in human resource development programs; developing a results-oriented approach based on specific criteria or standards; designing instruments; determining program costs; and collecting, analyzing, and interpreting data to ascertain return on investment. *Preq:* AG ED (CTE, ED) 889, H R D (CTE) 847, (CTE) 860 or consent of instructor.

H R D (CTE) 860 Instructional Materials Development 3(3,0) Development and application of instructional materials and laboratory activities for training programs in education and industry; reinforcement of instructional training concepts and materials development procedures that are applied across human resource development (HRD) programs. *Preq:* H R D (CTE) 845.

H R D (CTE) 870 Consulting for Education and Industry 3(3,0) Theory and practice of external and internal consulting practices in human resource development programs; dynamics of a professional helping relationship; methods and techniques for initiating and terminating consulting relationships; diagnosing client situations; identification, selection, and implementation of alternative problem solutions; evaluation of professional consulting relationships. *Preq:* H R D 830 or consent of instructor.

H R D 880 Research Concepts and Skills 3(3,0) Introductory course in research to familiarize human performance improvement professionals with the nature of research and reporting processes and to help develop the necessary criteria to become critical, analytical consumers of published research. *Preq:* H R D 820, 830.

H R D 882 Knowledge Management for Improved Performance 3(3,0) Introduction to knowledge management to familiarize students with organizational competencies required to adapt and prosper in a chaotic, global environment. Focuses on contemporary theory, research, and application of knowledge management as a strategy for improving personal and organizational performance. *Preq:* H R D 880.

H R D 890 Instrumentation for Human Performance Improvement 3(3,0) Introduction to commercially available instruments used to assess and evaluate human performance in the workplace. Students develop critical judgment skills to determine the adequacy and use of instruments in modern organizations. *Preq:* H R D 880.

H R D 897 Applied Research and Development 3(3,0) Study of a specific topic under the direction of a faculty member. Students identify a special problem related to the human resource development profession based on their personal interests, experiences, needs, and goals. *Preq:* Submission of a written proposal, prior approval of advisor, satisfactory completion of 12 hours of graduate H R D courses, AG ED (CTE, ED) 889.

HUMANITIES

HUM (ENGL) 656 Literature and Arts of the Holocaust 3(3,0) See ENGL 656.

HYDROGEOLOGY

See courses listed under Geology.

INDUSTRIAL ENGINEERING

I E 600 Honors Thesis 1-6(1-6,0) Individual or joint research project performed with a faculty mentor or committee of faculty. May be repeated for a maximum of six credits. *Preq:* I E H300 or consent of mentor.

I E 640 Decision Support Systems in Industrial Engineering 3(2,3) Design of decision support systems for production and service systems based on operations research models. Use of spreadsheets, databases, and integrated software development environments to implement decision support systems. *Preq:* I E 280; CP SC 161 or I E 220.

I E 652 Reliability Engineering 3(3,0) Probabilistic approach to assessing system reliability. Methods for analyzing serial, parallel, and complex systems. Reliability life testing and its acceleration are covered. Essential elements of maintainability are identified and related to system availability. *Preq:* I E 360.

I E 656 Supply Chain Design and Control 3(3,0) Industrial engineering aspects of supply chains including design and control of material and information systems. *Preq:* I E 386.

I E 657 Transportation and Logistics Engineering 3(3,0) Introduces transportation and logistics systems analysis from both analytical and practical perspectives. Covers methods for identifying level-of-service metrics and measuring system performance. Discusses key aspects of modeling, simulation, and other techniques for economic and quantitative analysis of transportation and logistics planning issues. *Preq:* Senior standing in engineering, science, or management program; MTHSC 102 or 106.

I E 660 Quality Improvement Methods 3(3,0) Study of modern quality improvement techniques presented in an integrated, comprehensive context. *Preq:* Junior standing.

I E 661 Quality Engineering 3(3,0) Design aspects of quality and the engineer's role in problems of quality in production systems. *Preq:* I E 360.

I E 662 Six Sigma Quality 3(3,0) Study of DMAIC (Define, Measure, Analyze, Improve, and Control) elements of Six Sigma, project management, process analysis, quality function deployment, hypothesis testing, gage R&R, data analysis, multivariate analysis, design of experiments, statistical process control, and process capability analysis. *Preq:* EX ST 301, 411, I E 360, MTHSC 301, 302, or 309.

I E 665 Facilities Planning and Design 3(3,0) Study of the principles and techniques of facility planning and design. Discusses economic selection of materials handling equipment and integration of this equipment into the layout plan to provide effective product flow in production, distribution, and service contexts. Includes quantitative techniques for evaluation of facilities design. *Preq:* I E 280.

- I E 677 Systems Safety 3(2,3)** Introduces the issue of safety and response to significant events. Provides exposure to and experience in hazard and accident causes and mitigation. Emphasizes current theories applied to large, complex systems. *Preq:* Senior standing.
- I E 682 Systems Modeling 4(4,0)** Modeling of discrete industrial systems using a digital computer. The purpose, theory, and techniques of system modeling are presented. *Preq:* I E 381.
- I E 685 Industrial Systems Engineering 3(3,0)** Modeling and analysis of multistage decision processes, recursive optimization, process and system design, and control problems. *Preq:* I E 280, 381.
- I E 687 Industrial Safety 3(3,0)** Recognition and prevention of hazards; recognition and control of hazardous materials; developing and managing a safety program; designing inherently safe equipment and workplaces. *Preq:* Junior standing.
- I E 688 Human Factors Engineering 3(3,0)** Introduction to human performance and limitations in the design of effective and efficient systems. Covers issues related to changes in technology, impact of design on society, ethical issues in design of systems, and the cost benefits from designing systems and environments that often challenge perceived notions of benefits. *Preq:* Junior standing; MTHSC 102 or 106.
- I E 689 Industrial Ergonomics and Automation 3(2,3)** Physical ergonomics and ergonomics in industrial settings including work physiology, the physical environment, automated systems, and hybrid work systems. *Preq:* I E 210 or Senior standing.
- I E 691 Selected Topics in Industrial Engineering 1-3(0-3,0-9)** Comprehensive study of any timely or special topic in industrial engineering not included in other courses. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.
- I E 800 Human Factors Engineering 3(3,0)** Fundamentals of design for human use; human performance; applications of abilities, and limitations to the design of tools, machines, facilities, tasks, and environments for efficient, safe, and comfortable human use. *Preq:* Consent of instructor.
- I E 801 Design and Analysis of Human-Machine Systems 3(3,0)** Methodologies used in the design and evaluation of human-machine systems including function and task analysis; questionnaires and interviews; scenarios, mock-ups, and prototypes; participative design, empirical testing, and iterative design; models of human-system interaction; analysis and classification of human error; and design of job performance and training aids. *Preq:* Graduate standing and consent of instructor.
- I E 802 Design of Human-Computer Systems 3(3,0)** Issues in designing, implementing, maintaining, and refining the user interface of interactive computer systems including interface design theories, models, principles, and guidelines; interaction styles; input and output devices; system messages; screen design, manuals, on-line help, and tutorials; and iterative design, testing, and evaluation. *Preq:* I E 801 or consent of instructor.
- I E 803 Engineering Optimization and Applications 3(3,0)** Introduction to optimization through the study of problems related to the planning, design, and control of production/manufacturing systems; classical nonlinear optimization and algorithmic procedures, primal and dual problems with postoptimality analysis, Markov chains. *Preq:* Graduate standing and consent of instructor.
- I E 804 Manufacturing Systems Planning and Design 3(3,0)** Concepts and principles associated with the design of manufacturing systems with a focus on modeling and integration methodologies; group technology, process planning, manufacturing modeling, and design for manufacturing. *Preq:* Graduate standing and consent of instructor.
- I E 805 Foundations in Quality Engineering 3(3,0)** Fundamental tools of quality engineering and their application to real situations; advanced statistical process control, design of experiments, Taguchi techniques, and Shainin methodologies. *Preq:* Graduate standing and consent of instructor.
- I E 807 Discrete Systems Simulation 3(3,0)** Constructing computer models to represent existing real-world systems or hypothetical future systems; experimenting with these models to explain system behavior, improve system performance, or design new systems with desirable performances. *Preq:* MTHSC 302 and I E 809 or consent of instructor.
- I E 809 Model Systems Under Risk 3(3,0)** Application of probabilistic methods to engineering problem solving and decision making. Cases are presented illustrating use of Markov chains, queuing processes, and other stochastic models in practice. *Preq:* MTHSC 302 or consent of instructor.
- I E 811 Human Factors in Quality Control 3(3,0)** Aspects of use of the human as a detector of product quality, serving as the basis for a taxonomy of human tasks in inspection; incorporates models of visual search and human decision making within the quality control framework. *Preq:* Graduate standing and consent of instructor.
- I E 812 Work Science and Design 3(3,0)** Design methods for work and work systems; scientific and engineering basis of work and its analysis. *Preq:* Consent of instructor.
- I E 813 Occupational Ergonomics 3(3,0)** Theory and applications of ergonomics at work; human performance, fatigue, stress, work patterns, work environment.
- I E 815 Research Methods in Ergonomics 3(2,2)** Contexts and processes for research in ergonomics with emphasis on engineering problems; scientific and engineering methods; measurement; visual and physical tasks; simulation, laboratory and archival studies. *Preq:* MTHSC 884 or equivalent or consent of instructor.
- I E 850 Introduction to Capital Projects Supply Chain 3(3,0)** Introduces the phases of capital projects; design and control of the capital projects supply chain; challenges associated with each of the primary supply chain entities—owners, contractors, and suppliers.
- I E 851 Data Collection, Analysis, and Interpretation 3(3,0)** Collection and presentation of data for decision making in industry focusing on design and control of industrial processes. Includes application of inferential statistics to data from industrial engineering situations. *Preq:* I E 850 or consent of instructor.
- I E 852 Modeling and Decision Making 3(3,0)** Students formulate and resolve models of industrial engineering systems focusing on decision making. *Preq:* I E 851 or consent of instructor.
- I E 853 Foundations of Quality 3(3,0)** Discusses quality control and quality assurance techniques including control charting and supplier surveillance. Special attention is devoted to non-traditional applications such as those used in nonmanufacturing supply chain. *Preq:* I E 850 or consent of instructor.
- I E 854 Fundamentals of Supply Chain and Logistics 3(3,0)** Students apply model building and analytical techniques to design, optimize, and control the supply chain and other logistics systems. *Preq:* I E 851 or consent of instructor.
- I E 855 Capital Projects Supply Chain 3(3,0)** Application of quantitative and qualitative tools and techniques to the design, control, management, and optimization of the capital projects supply chain. *Preq:* MGT 856 or consent of instructor.
- I E 857 Industrial Safety and Risk Management 3(3,0)** Discusses safety and risk management issues in industrial engineering systems including hazard information systems, process safety, export control, and federal and international safety regulation requirements. *Preq:* I E 850 or consent of instructor.
- I E 858 Case Studies in Capital Projects Supply Chain 3(3,0)** Analysis of case studies in the capital projects supply chain. *Preq:* I E 852, 853, 854, 855, 857, or consent of instructor.
- I E 859 Capstone Design Project 3(3,0)** Capstone experience in the design, control, management, and optimization of capital projects supply chains. *Preq:* I E 858 or consent of instructor.
- I E 860 Dynamic Programming 3(3,0)** Theory and methodology of dynamic programming; Bellman's principle of optimality; Mitten's sufficiency conditions; recursive optimization of serial and nonserial multistage systems; optimization of discrete and continuous systems through decomposition; special aspects of problem formulation. *Preq:* I E 803.
- I E 865 Facility Planning and Design 3(3,0)** Planning and design of industrial facilities emphasizing automated production facilities; quantitative approaches to equipment design and evaluation of performance. *Preq:* I E 803.
- I E 871 Industrial Testing and Quality 3(3,0)** Design and use of component and product tests; automated inspection; test and inspection in integrated systems; cost-based models. *Preq:* I E 661.
- I E 880 Advanced Methods of Operations Research 3(3,0)** Methods and applications of advanced operations research techniques; discrete optimization, integer, and mixed integer programming, Boolean minimization, network optimization, permutization methods on implicit enumeration. *Preq:* I E 803 or consent of instructor.

I E 881 Metaheuristics 3(3,0) Survey of selected metaheuristic techniques. Topics may include genetic algorithms and other evolutionary algorithms, tabu search, and simulated annealing. Students implement multiple metaheuristics from problems throughout the semester in a high-level language.

I E 884 Advanced Engineering Economic Analysis 3(3,0) Engineering economic analysis for engineering research, development, and construction projects emphasizing detailed treatment of tax effects, methods for determining discount rates, proper use of economic criteria in various decision environments (certainty vs. uncertainty, single vs. multiple project selections, etc.). *Preq:* Consent of instructor.

I E 886 Operations Research in Production Control 3(3,0) Latest techniques in scientific inventory management, scheduling, and forecasting; operations research; statistics; computer methods; case studies. *Preq:* I E 803.

I E 888 Advanced Probabilistic Methods 3(3,0) Advanced treatment of stochastic optimization, potentially including single and multiple channel queues, Markov programming, and stochastic optimal control. *Preq:* Consent of instructor.

I E 890 Special Problems in Industrial Engineering 1-3(1-3,0) Principles and methods of industrial engineering applied to analysis of a current interest problem. May be repeated for a maximum of six credits. To be taken Pass/Fail only. *Preq:* Consent of instructor.

I E 891 Master's Thesis Research 1-12

I E 892 Master's Design Project 3(1,6) Design project in industrial systems; integration of industrial engineering principles and methodologies; resolution of contemporary systems design problems. Project requires research, development, implementation planning, reporting, and project assessment. *Preq:* Consent of instructor.

I E 893 Selected Topics in Industrial Engineering 1-3(1-3,0) Selected topics in industrial engineering emphasizing new developments in systems science, systems analysis, and operations research. May be repeated for credit. *Preq:* Consent of instructor.

I E 895 Industrial Engineering Research Techniques 1(1,0) Series of weekly one-hour lectures given by students, faculty, and guests on methods and issues involved in industrial engineering research. To be taken Pass/Fail only.

I E 971 Advanced Quality Engineering Seminar 3(3,0) Current topics in the research and development of quality engineering methodologies. *Preq:* I E 871 or consent of instructor.

I E 991 Doctoral Dissertation Research 1-12

INTEGRATED PEST MANAGEMENT

I P M 601 Principles of Integrated Pest Management 3(3,0) Origins, theory, and practice of integrated pest management. Relationships among crop production and protection practices are explored. Economics of various control strategies are considered. Integrated pest management field projects are studied. Conventional and integrated pest management approaches are compared. Multidisciplinary plant problem analysis is introduced. *Preq:* CSENV 407, ENT 301, PL PA 310, or consent of instructor.

I P M 700 Internship in Plant Health 1-5 Professional employment under competent supervision in an approved agency or organization dealing with the vocational or occupational aspects of plant health. During the internship, students submit weekly reports covering the experience. A terminal report is also required. To be taken Pass/Fail only. *Preq:* Second semester graduate standing, I P M 601, consent of instructor.

I P M 800 Special Problems in Plant Health 1-3(0,3-9) Directed individual study of a special problem in plant health. Emphasis is on organizing, conducting, and reporting on independent investigation. *Preq:* Consent of instructor.

LANDSCAPE ARCHITECTURE

LARCH 605 Urban Genesis and Form 3(3,0) Exploration of urban forms and developments within their historic context through off-campus, on-site lectures and exposure to historic cities and sites. Students visit historic and contemporary cities and analyze those places through readings and direct observations. Offered Maymester only. *Preq:* LARCH 252 or consent of instructor.

LARCH 623 Environmental Issues in Landscape Architecture 3(3,0) Overview of environmental and ecological issues and their relationship to landscape architecture practice and design. *Preq:* LARCH 452 or consent of instructor.

LARCH 633 Historic Preservation in Landscape Architecture 3(3,0) Study of historic landscape preservation in a number of contexts including gardens, vernacular landscapes, parks, cemeteries, and battlefields. *Preq:* LARCH 452 or consent of instructor.

LARCH 643 Community Issues in Landscape Architecture 3(3,0) In-depth study of issues relevant to community design. Overview of physical design and related social issues. *Preq:* LARCH 452 or consent of instructor.

LARCH 653 Key Issues in Landscape Architecture 3(3,0) Overview of research in landscape architecture and study of relevant research methods. Students write proposals for their own projects positioned within the larger context of research in the profession. *Preq:* Fifth-year Landscape Architecture student or graduate student, or consent of instructor.

LARCH 801 Landscape Architecture Orientation I 6(3,9) Focused study of design, design theory, and design communication. Assigned readings, lectures, and discussions link those topics to graduate-level explorations of design intervention in the cultural and natural landscape. *Preq:* Students in First Professional MLA program or consent of instructor.

LARCH 802 Landscape Architecture Orientation II 6(3,9) Second-semester course of focused study in design, design theory, and design communication. Assigned readings, lectures, and discussions link those explorations to graduate-level study in nature, culture, and design. Explorations begun in LARCH 801 are taken to greater depth and complexity. *Preq:* Students in First Professional MLA program or consent of instructor.

LARCH 813 Advanced Regional Design 6(3,9) Advanced study and analysis of natural and cultural landscapes at the regional scale with an emphasis on South Carolina. Includes an exploration of landscape ecology as an informant to design and application geographic information systems. Each student also engages in independent research. *Preq:* Students in Second Professional MLA or MARCH program or consent of instructor.

LARCH 823 Advanced Community Design Studio 6(3,9) Studio focused on the study of communities. Students engage in a series of design explorations culminating in a mixed-use parcel on a large tract. Includes intensive study of growth and change in the contemporary landscape. New development in southeastern U.S. serves as a laboratory. *Preq:* LARCH 653 or consent of instructor.

LARCH 830 Graduate Seminar I 3(3,0) Seminar including reading, writing, and discussion on environmental and social/cultural issues in landscape architecture. Course is grounded in an exploration of the history of landscape architectural theory. *Preq:* LARCH 802 or consent of instructor.

LARCH 840 Graduate Seminar II 3(3,0) Graduate seminar in one of the areas of departmental focus: growth and change, health and design, or restoration. *Preq:* LARCH 830 or consent of instructor.

LARCH 843 Interdisciplinary Design and Research 6(3,9) Students participate in an interdisciplinary project linked to one of the focus areas in the department: health and design, restoration (environmental or cultural/historical), growth and change. Each student identifies a personal research project related to the larger team project. *Preq:* LARCH 653 or consent of instructor.

LARCH 850 Graduate Colloquium 3(3,0) Series of lectures and presentations by graduating students, faculty members, and guest designers and scholars. Students offer reviews and critiques of the various presentations. *Preq:* LARCH 840 or consent of instructor.

LARCH 853 Advanced Interdisciplinary Design and Research 6(3,9) Continuation of LARCH 843 with an advanced interdisciplinary project linked to one of the focus areas in the department: health and design, restoration (environmental or cultural/historical), and growth and change. Each student identifies a personal research project related to the larger team project. *Preq:* LARCH 843 or consent of instructor.

LARCH 890 Directed Studies 1-6(1-6,0) Special topics and independent research in landscape architecture with faculty guidance. May be repeated for a maximum of six credits. *Preq:* Consent of advisor.

LARCH 891 Thesis Project 6(1,15) Complex and sophisticated independent project in landscape architectural research and/or advanced design. *Preq:* LARCH 843 or consent of instructor.

LANGUAGE

LANG 600 Phonetics 3(3,0) Study of basic phonetic concepts used in the study of sounds and language.

LANG (PO SC) 685 Global Affairs and Governments 3(3,0) See PO SC 685.

LAW

LAW 605 Construction Law 3(3,0) Provides a practical knowledge of legal principles applied to the construction process and legal problems likely to be encountered by the practicing construction professional. Topics include construction contracting, liability, claims and warranties, documentation, and responsibility and authority of contracting parties. *Preq:* LAW 322 or consent of instructor.

LAW 620 International Business Law 3(3,0) Intensive examination of the historical background of modern public and private international law; selected issues of public international law—human rights, law of war, United Nation's system, and international litigation; selected issues of private international law—international sales, international trade, and formation and operation of multinational businesses. *Preq:* LAW 322 or consent of instructor.

LAW 848 Law for Real Estate Professionals 3(3,0) Provides the real estate professional with the fundamentals of law as it applies in the real estate arena. Explores the various legal forms of ownership, the form and process of real estate transactions, and governmental regulation of land use. *Preq:* Graduate standing or consent of instructor.

LAW 850 Law for Professional Accountants 3(3,0) Preparation for professional exams and responsibilities in managerial positions. Topics include professional and legal responsibilities of accountants, business organizations, commercial law, government regulation of business and property. Case studies, problems, and student papers are utilized. *Preq:* LAW 322 or equivalent.

M B A

See courses listed under Business Administration.

MANAGEMENT

MGT 803 Operations Management 3(3,0) Introduction to a broad range of operations management topics. Serves as a foundation for understanding the importance, relevance, and significance of analytical models and tools to be introduced in subsequent courses in the MS in Management program. Topics include operations strategy, process and facility design, planning and control, quality management, and continuous improvement. Offered fall semester only.

MGT 804 Operations Strategy 3(3,0) In-depth study, through case studies and readings, of the role operations systems capabilities play in providing sources of competitive advantage. Topics include industry analysis, technological forecasting, formulation of organization and operations strategies, and development of operations system capabilities. *Preq:* MGT 803 or consent of instructor. Offered fall semester only.

MGT 806 Industrial Management Internship 0 Faculty-approved internship to give MS in Management students on-the-job learning in support of classroom education. Internships must be at least six, full-time, consecutive weeks with the same internship provider. May be repeated. *Preq:* Consent of graduate coordinator.

MGT 807 Comparative Management Theory 3(3,0) Evolution of management theory, up to and including contemporary theories; comprehensive review of the major schools of management thought, with emphasis on the area of organization theory and design.

MGT 808 Manufacturing Planning and Control Systems 3(3,0) Important components of a manufacturing planning and control system emphasizing the integration of planning and control functions in a dynamic manufacturing environment; extensive hands-on work with integrated manufacturing software. Offered spring semester only. *Preq:* MGT 803 or consent of instructor.

MGT (M B A) 809 Organizational Behavior and Human Resources Management 3(3,0) See M B A 809.

MGT 812 Supply Chain Management 3(3,0) In-depth study, through case studies and readings, of methodologies for designing and managing integrated, international supply chain networks. Topics include supply network design, distribution strategy, strategic alliances, inventory management, coordinated product and network design, and information systems for supply chain. Offered fall semester only. *Preq:* Consent of instructor.

MGT 815 Personnel Management 3(3,0) Personnel management activities including recruitment, selection, training and development, performance appraisal, discipline, grievance handling, wage and salary administration, and employee benefit programs.

MGT 818 E-Commerce Web Site Development 3(2,1) Enabling information technologies for electronic commerce, including databases and Web applications. These technologies are applied to a project. *Preq:* Computer programming experience.

MGT 819 Web-Based Information Systems for Supply Chain Management 3(2,1) Examines system architectures, technologies, approaches, and infrastructure requirements for supply-chain information systems. Students learn to design, develop, and implement systems that facilitate collaboration of an enterprise with its buyers and suppliers. *Preq:* MGT 812 and 818 or consent of instructor.

MGT 820 Service Operations Management 3(3,0) Concepts and techniques of service operating system design and management. Topics include characteristics of services, service system performance measurement, queuing and automation, planning and control in different service environments, and international service operations. *Preq:* MGT 803 or consent of instructor.

MGT 821 Lean Operations 3(3,0) Examines uses of the scientific method, the Toyota Production System and the application of the appropriate tools and methods to design both service and production operations. Development of systems that promote lean operations is emphasized. *Preq:* M B A 806, M B A 856, or MGT 803 or consent of instructor.

MGT 822 International Operations Management 3(3,0) Operations management within an international business environment. Topics include the regulatory and cultural environment of international business, international business and operations strategies, global location, global sourcing and logistics decisions, international workforce management, technology transfer and configuration, and coordination of global operations activities. *Preq:* MGT 803 or consent of instructor.

MGT 823 Management Systems Analysis 3(3,0) Design, construction, and analysis of stochastic simulation models for typical management decisions; design; input-output; variance reduction; applications; validation; implementation; optimum seeking techniques; designed experiments; effect of model results on managerial policy decisions.

MGT 829 Management of E-Commerce 3(3,0) Concepts of electronic commerce as facilitated by the Internet and related technologies. Topics include the catalysts for e-commerce (both B2B and B2C), technological challenges, legal and regulatory framework, behavior and educational challenges, and strategies for e-commerce. *Preq:* Consent of instructor.

MGT 830 E-Business Strategy 3(3,0) Theory and practice of business strategy in the e-business firm, emphasizing building competitive advantage and increasing shareholder value through digital technologies. The roles of technical and general managers in electronic business are investigated through business cases and class discussion. MS in Management and MBA students may not receive credit for this course. *Preq:* M B A 876, MGT 829.

MGT 833 E-Commerce Project 3(0,9) Application of e-commerce knowledge to a significant problem or opportunity. *Preq:* Submission of a written proposal and consent of instructor.

MGT (M B A) 845 Technology and Innovation Management 3(3,0) See M B A 845.

MGT 850 Business Decision Models 3(3,0) Fundamental management science modeling techniques emphasizing problem formulation, computer solution, and economic analysis in an operations context; queuing analysis, computer simulation, and mathematical programming approaches including linear, goal, and integer programming. Application areas encompass production, capacity, and project planning, scheduling, location, layout, and logistics. *Preq:* Consent of instructor.

- MGT 852 Management Science II 3(3,0)** Continuation of MGT 850; dynamic, integer, and nonlinear programming emphasizing applications of different types of mathematical programming to business and industrial problems. *Preq:* MGT 850 or consent of instructor.
- MGT 854 Design of Experiments in Business and Management 3(3,0)** Design and analysis of experiments with a focus on business and industrial applications. Topics range from the analysis of single-factor experimental designs through factorial experiments, multiple comparisons, and confounding. Problems arising in the actual industrial environments are used to illustrate the application of the techniques and to introduce the student to major statistical software packages for the analysis of experimental data. Offered fall semester only.
- MGT 856 Business Fundamentals for Supply Chain Management 3(3,0)** Principles and techniques of leadership, human resources management, financial management, marketing, and economic analysis, particularly as they relate to the capital projects supply chain management.
- MGT (M B A) 861 Information Systems 3(3,0)** See M B A 861.
- MGT 866 System Analysis and Design 3(2,1)** Software engineering methods and techniques specific to analysis and design of information systems. Topics include concepts and methods for valuation of IT applications, data gathering, and process, data, and object-oriented modeling analysis and design.
- MGT 869 Project Management 3(3,0)** In-depth study, through case studies, readings, and hands-on experience, of processes and techniques to initiate, plan, execute, control, and close-out information technology projects. Topics include project integration, scope, time, cost, quality, human resource, communications, risk, and procurement management. *Preq:* Consent of instructor.
- MGT (M B A) 874 Managing Continuous Improvement 3(3,0)** See M B A 874.
- MGT 885 Industrial Scheduling 3(3,0)** Theoretical results for single and parallel machine, flow shop, job shop, and network scheduling; treatment of mathematical programming applications, scheduling algorithm design and search procedures. *Preq:* One of the following: C E 835, CP SC 840, I E 803, M B A 859, MGT 850, MTHSC 812 or 814; and consent of instructor.
- MGT 888 International Perspectives in Industrial Management 3-6(3-6, 0)** International perspective to industrial management via organized plant visitations to businesses in a foreign country and lectures by, and discussions with, senior operations managers. Cultural visits and lectures are also organized to provide a holistic perspective to cover cultural and economic development of the host country. *Preq:* Consent of instructor.
- MGT 891 Master's Thesis Research 1-12**
- MGT 892 Master's Project Course 3(0,9)** Field project, the capstone activity in the program, requiring application of the program body of knowledge to a real-world operations management problem. Formal presentation and written report are required. May be repeated for a maximum of 12 credits. To be taken Pass/Fail only. *Preq:* Consent of instructor.
- MGT 899 Selected Topics in Industrial Management 3(3,0)** Current topics in industrial management theory and/or practice. Topics vary in keeping with developments in the management profession and interests of faculty. May be repeated for a maximum of nine credits.
- MGT 903 Seminar in Manufacturing Planning and Control Systems 3(3,0)** Current research issues and developments in manufacturing planning and control systems emphasizing research (philosophical, analytical, and empirical) dealing with alternative approaches for planning and control of manufacturing operations. *Preq:* MGT 808, consent of instructor.
- MGT 904 Seminar in Current Management Topics 3(3,0)** Topics from current management literature emphasizing research from scholarly journals. Topics vary in keeping with developments in the literature. May be repeated with different faculty for a maximum of six credits. *Preq:* MGT 803 or consent of instructor.
- MGT 905 Research Methods 3(3,0)** Research methods supporting scholarly research and publication in management. Topics include theory building, hypothesis specification and testing, experimental design, measurement, sampling, research ethics, and related issues. Restricted to doctoral students. *Preq:* MGT 854 or equivalent.
- MGT 907 Seminar in the Design of Operations Systems 3(3,0)** Current management issues and developments in the evaluation, selection, design, and installation of systems for manufacturing and service operations; empirical research dealing with the building blocks of operations such as process technology scanning, selection, and installation; operations systems location and layout; and management systems selection and installation. *Preq:* MGT 821, consent of instructor.
- MGT 910 Seminar in Operations Management 1-3(1-3,0)** New methodological developments, both analytical and philosophical, in operations management; development of theory of management science; converting management theory into practice while considering behavioral and economic aspects of the problem. *Preq:* Consent of instructor.
- MGT 916 Directed Readings in Management 1-3(1-3,0)** Directed reading and research in the student's area of interest. May be repeated for a maximum of three credits. *Preq:* Consent of instructor.
- MGT 918 Seminar in Management Support Systems 3(3,0)** Contemporary topics in decision-oriented information systems research; structure of the field, research methodologies, and research opportunities. *Preq:* MGT 818 or consent of instructor.
- MGT 925 Seminar on Information Systems Foundations 3(3,0)** Foundations of information systems research including classical framework literature. Research philosophies, key methodologies and relevant theoretical underpinnings are discussed and debated.
- MGT 927 Seminar in Organizational Impacts of Information Systems 3(3,0)** Current theoretical and empirical research related to the organizational impacts of information systems. Research focuses on strategic and structural impacts of information technologies within and across organizations.
- MGT 991 Doctoral Dissertation Research 1-12**

MARKETING

- MKT 623 Promotional Strategy 3(3,0)** Emphasizes promotion as the communication function of marketing. Attention is given to communication theory and promotion's relation to mass and interpersonal communication. Factors affecting the promotional decision-making process are explored, and promotion as a competitive tool is examined. *Preq:* MKT 301 or consent of instructor.
- MKT 627 International Marketing 3(3,0)** Study of marketing from the international point of view. Emphasis is on the necessary modification of marketing thinking and practice for foreign markets due to individual environmental differences. *Preq:* MKT 301.
- MKT 628 Services Marketing 3(3,0)** Exploration and study of the nature of service organizations and the principles that guide the marketing of their products. Emphasis is on a marketing mix that is fundamentally different than that found in traditional goods marketing. *Preq:* MKT 301 or consent of instructor.
- MKT 629 Public and Nonprofit Marketing 3(3,0)** Examines the role and application of marketing in public and nonprofit settings. Focuses on a conceptual understanding of the marketing discipline and marketing processes and shows how basic concepts and principles of marketing are applicable to public and nonprofit organizations. *Preq:* MKT 301 or consent of instructor.
- MKT 630 Marketing Product Management 3(3,0)** Management of the firm's product or service offerings. Topics include new product screening, evaluation, and development; product line and mix analysis; abandonment decisions; brand manager's role; new product development department and others. Emphasis is on decision making. *Preq:* MGT 310, MKT 301; or consent of instructor.
- MKT 695 Selected Topics 3(3,0)** In-depth examination of timely topics in marketing. May be repeated for credit, but only if different topics are covered. *Preq:* MKT 301 or consent of instructor.
- MKT (M B A) 826 Business Marketing 3(3,0)** See M B A 826.
- MKT (M B A) 828 Services Marketing 3(3,0)** See M B A 828.

MKT 860 Advanced Marketing Strategy 3(3,0)

Advanced marketing theory and critical thinking skills applied to support strategic decision making. Data analysis and advanced marketing models are employed with emphasis on building analytic and assessment skills. Offered spring semester only. *Preq:* M B A 858 or MKT 865 or consent of instructor.

MKT 861 Marketing Research 3(3,0)

Marketing theory and critical thinking to support decision making; data analysis and advanced marketing models are employed with emphasis on building assessment skills. Primary topics are gathering primary and secondary data, questionnaire design, sampling, experimental design, data collection, and data analysis. *Preq:* Enrollment in MS in Marketing or MKT 860 or consent of instructor.

MKT 862 Quantitative Methods in Marketing 3(3,0)

Advanced quantitative analytic methods and their use in translating facts into meaningful information. Provides practical understanding of several advance quantitative data analytic procedures including both predictive and interdependence techniques. Application to case analysis format to broaden analysis skills. *Preq:* MKT 861 or consent of instructor.

MKT 863 Buyer Behavior 3(3,0)

Buyer decision processes in the purchase and consumption of goods and services by both businesses and consumers. Topics include economic, sociocultural, and psychological aspects of buying behavior; decision-making processes and buyer choice; individual and group level influences on consumer behavior; and implications of consumer behavior for marketers. *Preq:* Enrollment in MS in Marketing or MKT 860 or consent of instructor.

MKT 865 Seminar in Marketing Management 3(3,0)

Current research and practice in components of marketing management. In-depth discussion of marketing mix variables, segmentation, targeting and positioning, and budget-related issues. *Preq:* Enrollment in MS in Marketing.

MKT 866 Selected Topics in Marketing 3(3,0)

Current topics in marketing theory and research. Topics vary with developments in the marketing profession. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* MKT 860 or 865 or consent of instructor.

MKT 870 Master's Research Project 1-5

Student development and participation in research. Application to a current business problem or development of new research. Formal presentation and written report are required. May be repeated for a maximum of five credits. *Preq:* Enrollment in MS in Marketing and consent of graduate advisor.

MASTER OF BUSINESS ADMINISTRATION (MBA)

See courses listed under Business Administration.

MATERIALS SCIENCE AND ENGINEERING

MS&E 800 Seminar in Materials Research 1(1,0)

Special topics and original research in materials science, materials engineering, and polymer and fiber chemistry. To be taken Pass/Fail only.

MS&E 820 Deformation Mechanisms in Solids 3(3,0)

Dislocation theory of solids; mechanisms of plastic deformation in single crystals and polycrystalline aggregates of metals and nonmetals; ductile and brittle fractures; fatigue, creep, and stress corrosion cracking of metals. *Preq:* Consent of instructor.

MS&E 821 Fracture and Fatigue 3(3,0)

Investigation into stress-strain-time relations in elasticity, plasticity, and rupture showing effects of high- and low-temperature structures. *Preq:* MS&E 820 or consent of instructor.

MS&E 825 Solid State Materials Science 3(3,0)

Bonding and structure of crystalline materials as related to mechanical, thermal, and chemical properties of solids.

MS&E 826 Phase Equilibria in Materials Systems 3(3,0)

Advanced treatment of phase equilibria in materials systems, phase diagrams, thermodynamics of defects, surfaces, interfaces, and solutions. *Preq:* C M E 210; consent of instructor. *Coreq:* M E 810.

MS&E 827 Kinetics of Phase Transformation 3(3,0)

Advanced treatment of the kinetics of phase transformation in materials systems including nucleation, growth, and spinodal decomposition. *Preq:* MS&E 826 or equivalent, consent of instructor.

MS&E 828 Phase Transformations in Materials Science 3(3,0)

Advanced treatment of gas-solid, gas-liquid, liquid-solid, and solid-solid transformations in materials systems. *Preq:* MS&E 827.

MS&E 891 Master's Thesis Research 1-12**MS&E 991 Doctoral Dissertation Research 1-12**

MATHEMATICAL SCIENCES

MTHSC 600 Theory of Probability 3(3,0)

Principal topics include combinatorial theory, probability axioms, random variables, expected values, special discrete and continuous distributions, jointly distributed random variables, correlation, conditional expectation, law of large numbers, central limit theorem. *Preq:* MTHSC 206 or consent of instructor.

MTHSC 603 Introduction to Statistical Theory 3(3,0)

Principal topics include sampling distributions, point and interval estimation, maximum likelihood estimators, method of moments, least squares estimators, tests of hypotheses, likelihood ratio methods, regression and correlation analysis, introduction to analysis of variance. *Preq:* MTHSC 400 or equivalent.

MTHSC 605 Statistical Theory and Methods II 3(3,0)

Principal topics include simple linear regression, multiple regression and correlation analysis, one-way analysis of variance, multiple comparison, multifactor analysis of variance, experimental design. Computation and interpretation of results are facilitated through use of statistical computer packages. *Preq:* MTHSC 301.

MTHSC 606 Sampling Theory and Methods 3(3,0)

Probability-based treatment of sampling methodology. Theory and application of estimation techniques are treated using simple and stratified random sampling, cluster sampling, and systematic sampling. *Preq:* MTHSC 302 and 400, or consent of instructor.

MTHSC 607 Regression and Time Series Analysis 3(3,0)

Theory and application of the regression and time series. Approaches to empirical model building and data analysis are treated. Computation and interpretation of results are facilitated through the use of interactive statistical packages. *Preq:* MTHSC 302, 311, 400; or consent of instructor.

MTHSC 608 Topics in Geometry 3(3,0)

Introduction to topics in special geometries which include non-Euclidean space concepts such as projective geometry, finite geometries, and intuitive elementary topology. Brief introduction to vector geometry. *Preq:* MTHSC 206.

MTHSC 612 Introduction to Modern Algebra 3(3,0)

Introduction to the concepts of algebra. Topics include the number system and the elementary theory of groups, rings, and fields. *Preq:* MTHSC 311.

MTHSC 619 Discrete Mathematical Structures I 3(3,0)

Applies theoretical concepts of sets, functions, binary relations, graphs, Boolean algebras, propositional logic, semigroups, groups, homomorphisms, and permutation groups to computer characteristics and design, words over a finite alphabet and concatenation, binary group codes, and other communication or computer problems. *Preq:* MTHSC 311.

MTHSC 634 Advanced Engineering Mathematics 3(3,0)

Fourier series, Laplace and Fourier transform, and numerical methods for solving initial value and boundary-value problems in partial differential equations are developed. Applications to diffusion wave and Dirichlet problems are given. Matrix methods and special functions are utilized. *Preq:* MTHSC 208.

MTHSC 635 Complex Variables 3(3,0)

Elementary functions; differentiation and integration of analytic functions; Taylor and Laurent series; contour integration and residue theory; conformal mapping; Schwarz-Christoffel transformation. *Preq:* MTHSC 206.

MTHSC 640 Linear Programming 3(3,0)

Introduction to linear programming covering the simplex algorithm, duality, sensitivity analysis, network models, formulation of models, and the use of simplex codes to solve, interpret, and analyze problems. *Preq:* MTHSC 206, 311, or consent of instructor.

MTHSC 641 Introduction to Stochastic Models 3(3,0)

Introductory treatment of stochastic processes, finite-state Markov chains, queueing, dynamic programming, Markov decision processes, reliability, decision analysis, and simulation. Both theory and applications are stressed. *Preq:* MTHSC 400.

MTHSC 653 Advanced Calculus I 3(3,0)

Limits, continuity, and differentiation of functions of one and several variables, the Riemann integral, and vector analysis. *Preq:* MTHSC 206.

MTHSC 654 Advanced Calculus II 3(3,0)

Continuation of MTHSC 653. Transformations, multiple integrals, line and surface integrals, infinite sequences and series, and improper integrals. *Preq:* MTHSC 453.

MTHSC 660 Introduction to Numerical Analysis I 3(3,0)

Introduction to the problems of numerical analysis emphasizing computational procedures and application. Topics include sources of error and conditioning, matrix methods, systems of linear equations, nonlinear equations, interpolation and approximation by splines, polynomials and trigonometric functions. *Preq:* MTHSC 206 or 207 and 360 or equivalent.

MTHSC 663 Mathematical Analysis I 3(3,0)

Basic properties of the real number system, sequences and limits; continuous functions, uniform continuity and convergence; integration, differentiation, functions of several real variables, implicit function theory. *Preq:* MTHSC 206.

MTHSC 706 Probability and Statistics for Middle Grades Teachers 3(3,0)

Topics include organizing, classifying, and summarizing data; univariate and bivariate graphical techniques; measures of center and dispersion; correlation and simple regression; elementary probability theory, counting, and simulations; binomial and normal distributions. A graphing calculator is used. *Preq:* Graduate standing in Middle Grades Education.

MTHSC 709 Geometry for the Middle Grades 3(3,0)

Hands-on approach to constructions with straight-edge and compass; polygons including tessellations and polyhedra; symmetry and transformational geometry; coordinate geometry measurement with dimensional analysis; perspective drawing and related topics; history of geometry; reasoning and informal proof with congruence; and computer software, calculator use, and Internet.

MTHSC 713 Algebra for Middle Grades Teachers 3(3,0)

Study of elementary algebra, solution of equations, and inequalities; properties and applications of linear, quadratic, polynomial, and exponential functions and models; graphical analysis and curve-fitting of real-world data; systems of equations and basic matrix operations. A graphing calculator is used. *Preq:* Graduate standing in Middle Grades Education.

MTHSC 714 Foundations of Mathematics for Middle Grades Teachers 3(3,0)

Topics include logic, set theory, numeration systems; arithmetic operations and their properties on the integer, rational, and real number systems; decimals, ratio, proportion, percent, exponents, and roots. Includes an introduction to algebra and counting, permutations, and combinations. *Preq:* Graduate standing in Middle Grades Education.

MTHSC 715 Quantitative Literacy I 3(3,0)

Data analysis and gathering data from surveys including box-and-whisker plots, bar charts, circle graphs, and stem-and-leaf plots. Construction of surveys to gather data to test a hypothesis. All material are presented by student activities using cooperative learning and manipulatives.

MTHSC 738 Modern Geometry for Secondary Teachers 3(3,0)

Concepts of Euclidean geometry reviewed and extended by means of coordinates, vectors, matrices; conic sections. *Preq:* Enrollment in Secondary Education graduate program.

MTHSC 740 Linear Programming for Secondary Teachers 3(3,0)

Development of mathematical theory of simplex algorithm; survey of mathematical background; matrix algebra, systems of linear equations and vector spaces; problem formulation is emphasized. *Preq:* Enrollment in Secondary Education graduate program.

MTHSC 749 Discrete Mathematics for Secondary Teachers 3(3,0)

Discrete mathematics emphasizing applications to computer science; propositions and logic; Boolean Algebra and switching circuits; recursion and induction; relations and partially ordered sets, graphs, and trees.

MTHSC 750 Modern Algebra for Secondary Teachers 3(3,0)

Introduction to the fundamental concepts and historical development of abstract algebra. Topics include integers, binary operations, functions, equivalence, relations, permutations, groups, polynomials, commutative rings, integral domains, and fields. *Preq:* MTHSC 311 or 753, Graduate standing in Secondary Education.

MTHSC 753 Matrix Algebra for Secondary Teachers 3(3,0)

Matrices and systems of equations; determinants; vector spaces and linear transformations; eigenvalues. *Preq:* Graduate standing in Secondary Education.

MTHSC 755 Combinatorial Analysis for Secondary Teachers 3(3,0)

Permutations; combinations; generating functions; recurrence relations; principle of inclusion-exclusion; partitions; Latin squares; block designs; finite geometries; graphs; codes; Polya's theorem; recreational mathematics. *Preq:* Graduate standing in Secondary Education.

MTHSC 756 Applied Modern and Linear Algebra for Secondary Teachers 3(3,0)

Various applied problems whose solutions rely on techniques and results of linear and modern algebra. Problems are selected from such areas as economics, forest management, genetics, population growth, transportation networks, cryptography, satellite communications, electronic switching circuits, chemistry, physics, sociology, and others. *Preq:* MTHSC 721 or equivalent or consent of instructor.

MTHSC 758 Number Theory for Secondary Teachers 3(3,0)

Topics include properties of integers, divisors, and prime numbers; fundamental properties of congruence; polynomials and primitive roots; quadratic residues. *Preq:* Graduate standing in Secondary Education.

MTHSC 775 AP Statistics Institute 3(3,0)

Topics include probability, conditional probability, descriptive statistics, random variables, probability functions, binomial distribution, normal distribution, sampling, estimation, decision making. *Preq:* Graduate standing in Secondary Education.

MTHSC 777 AP Calculus Institute 3(3,0)

Elementary functions, differential calculus and integral calculus; enrichment material and a theoretical perspective of calculus. Restricted to teachers who hold a current teaching certificate in secondary mathematics. Completion of this course satisfies the special certification requirements for AB-calculus teachers in South Carolina.

MTHSC 780 Probability Theory for Secondary Teachers 3(3,0)

Calculus-based introduction to basic ideas in probability theory. Topics include basic counting techniques, fundamental axioms of probability, conditional probability, discrete and continuous distributions, and sampling distributions. Emphasizes real-world applications and the use of simulations to illustrate concepts. *Preq:* MTHSC 108, Graduate standing in Secondary Education.

MTHSC 785 Data Analysis for Secondary Teachers 3(3,0)

Topics include data types, basic sampling and experimental designs, one- and two-sample confidence intervals and hypothesis tests, analysis of variance, model building with simple and multiple linear regression, and contingency tables. Includes a brief review of probability. Student groups propose and implement a real-world research project. *Preq:* MTHSC 301, 400, 600, or 780; Graduate standing in Secondary Education.

MTHSC 791 Selected Topics in Mathematics Education 1-3(1-3,0)

Mathematical problems in elementary or secondary school curricula. May be repeated for credit, but only if different topics are covered. *Preq:* Graduate standing in Elementary or Secondary Education.

MTHSC 800 Probability 3(3,0)

Study of basic probability theory with emphasis on results and techniques useful in operations research and statistics. Topics include axiomatic probability, advanced combinatorial probability, conditional informative expectation, functions of random variables, moment generating functions, distribution theory, and limit theorems. Offered fall semester only. *Preq:* MTHSC 206.

MTHSC 801 General Linear Hypothesis I 3(3,0)

Topics include least-square estimates; Gauss-Markov theorem; confidence ellipsoids, and confidence intervals for estimable functions; tests of hypotheses; one-, two-, and higher-way layouts; analysis of variance for other models. Offered fall semester only. *Preq:* MTHSC 311, 403.

MTHSC 802 General Linear Hypothesis II 3(3,0)

Continuation of MTHSC 801. Offered spring semester only.

MTHSC 803 Stochastic Processes 3(3,0)

Theory and analysis of time series, recurrent events, Markov chains, random walks, renewal theory, application to communication theory and operations research. *Preq:* MTHSC 400 or 800.

MTHSC 804 Statistical Inference 3(3,0)

Sampling distributions; maximum likelihood estimation and likelihood ratio tests; asymptotic confidence intervals for Binomial, Poisson, and Exponential parameters; two-sample methods; nonparametric tests; ANOVA; regression; model building. Offered fall semester only. *Preq:* MTHSC 400 or equivalent or consent of instructor.

MTHSC 805 Data Analysis 3(3,0)

Methodology in analysis of statistical data emphasizing applications to real problems using computer-oriented techniques: computer plots, transformations, criteria for selecting variables, error analysis, multiple and stepwise regression, analysis of residuals, model building in time series and ANOVA problems, jackknife and random subsampling, multidimensional scaling, clustering. *Preq:* MTHSC 301, 400.

- MTHSC 806 Nonparametric Statistics 3(3,0)**
Order statistics; tolerance limits; rank-order statistics; Kolmogorov-Smirnov one-sample statistics; Chi-square goodness-of-fit test; two-sample problem; linear rank statistics; asymptotic relative efficiency. Offered spring semester only. *Preq:* MTHSC 600 or 800.
- MTHSC 807 Applied Multivariate Analysis 3(3,0)**
Applied multivariate analysis: computer plots of multivariate observations; multidimensional scaling; multivariate tests of means, covariances, and equality of distributions; univariate and multivariate regressions and their comparisons; MANOVA; principal components analysis; factor analysis; analytic rotations; canonical correlations. Offered fall semester only. *Preq:* MTHSC 403 and 805 or consent of instructor.
- MTHSC 808 Reliability and Life Testing 3(3,0)**
Probability models and statistical methods relevant to parametric and nonparametric analysis of reliability and life testing data. Offered spring semester only. *Preq:* MTHSC 400 or equivalent.
- MTHSC 809 Time Series Analysis, Forecasting, and Control 3(3,0)**
Modeling and forecasting random processes; autocorrelation functions and spectral densities; model identification, estimation and diagnostic checking; transfer function models; feedforward and feedback control schemes. Offered spring semester only. *Preq:* MTHSC 605; 600 or 800; or equivalent.
- MTHSC 810 Mathematical Programming 3(3,0)**
Formulation and solution of linear programming models; mathematical development of the simplex method; revised simplex method; duality; sensitivity analysis; parametric programming, implementation and software packages. *Preq:* MTHSC 311.
- MTHSC 811 Nonlinear Programming 3(3,0)**
Theoretical development of nonlinear optimization with applications, classical optimization, convex and concave functions, separable programming, quadratic programming, and gradient methods. Offered spring semester only. *Preq:* MTHSC 440, 454.
- MTHSC 812 Discrete Optimization 3(3,0)**
Principal methods used in integer programming and discrete optimization; branch and bound, implicit enumeration, cutting planes, group knapsack, Lagrangian relaxation, surrogate constraints, heuristics (performance analysis), separation/branching strategies, and polynomial time algorithms for specific problems on special structures. Offered fall semester only. *Preq:* MTHSC 810 or equivalent.
- MTHSC 813 Advanced Linear Programming 3(3,0)**
Development of linear programming theory using inequality systems, convex cones, polyhedra and duality; solution algorithms, and computational considerations for large scale and special structured problems using techniques of upper bounded variables, decomposition, partitioning and column generation; game theory; nonlinear representations and other methods such as ellipsoid and Karmarkar. Offered spring semester only. *Preq:* MTHSC 440, 810 or equivalent.
- MTHSC 814 Network Flow Programming 3(3,0)**
Max-flow/min-cut theorem, combinatorial applications, minimum cost flow problems (transportation, shortest path, transshipment), solution algorithms (including the out-of-kilter), and implementation and computational considerations. Offered fall semester only. *Preq:* MTHSC 440, 810 or equivalent.
- MTHSC 816 Network Algorithms and Data Structures 3(3,0)**
Design, analysis, and implementation of algorithms and data structures associated with the solution of problems formulated as networks and graphs; applications to graph theory, combinatorial optimization, and network programming. Offered spring semester only. *Coreq:* MTHSC 640, 810, 854, 863 or consent of instructor.
- MTHSC 817 Stochastic Models in Operations Research I 3(3,0)**
Stochastic control; structure of sequential decision processes; stochastic inventory models; recursive computation of optimal policies; discrete parameter finite Markov decision processes; various optimality criteria; computation by policy improvement and other methods; existence of optimal stationary policies; stopping-rule problems; examples from financial management, maintenance and reliability, search, queuing, and shortest path. Offered spring semester only. *Preq:* MTHSC 803.
- MTHSC 818 Stochastic Models in Operations Research II 3(3,0)**
Introduction to queuing theory: Markovian queues, repairman problems, queues with an embedded Markov structure, the queue GI/G/1, queues with a large number of servers, decision making in queues; introduction to reliability theory; failure distributions; stochastic models for complex systems; maintenance and replacement policies; reliability properties of multicomponent structures. Offered fall semester only. *Preq:* MTHSC 817.
- MTHSC 819 Multicriteria Optimization 3(3,0)**
Theory and methodology of optimization problems with vector-valued objective functions; preference orders and domination structures; generating efficient solutions; solving multicriteria decision-making problems; noninteractive and interactive methods with applications. Offered fall semester only. *Preq:* MTHSC 810 or equivalent.
- MTHSC 820 Complementarity Models 3(3,0)**
Theory, algorithms, and applications of linear and nonlinear complementarity; classes of matrices and functions and corresponding algorithms; applications to economics, mechanics, and networks; generalizations to fixed-point problems and nonlinear systems of equations. Offered spring semester only. *Preq:* MTHSC 810.
- MTHSC 821 Linear Analysis 3(3,0)**
Normed spaces; Hilbert spaces, Banach spaces, linear functionals, linear operators, orthogonal systems. Offered spring semester and summer session only. *Preq:* MTHSC 454 or 453 and 853.
- MTHSC 822 Measure and Integration 3(3,0)**
Rings and algebras of sets, inner and outer measures; measurability and additivity, examples on the line and in space, Lebesgue integration, types of convergence, Lebesgue spaces; integration and differentiation, product measure, Fubini theorem. Offered fall semester only. *Preq:* MTHSC 454.
- MTHSC 823 Complex Analysis 3(3,0)**
Topological concepts; complex integration; local and global properties of analytic functions; power series; representation theorems; calculus of residues. Designed for nonengineering majors.
- MTHSC 825 Introduction to Dynamical Systems Theory 3(3,0)**
Techniques of analysis of dynamical systems; sensitivity analysis, linear systems, stability, and control; theory of differential and difference equations. Offered fall semester only. *Preq:* MTHSC 454 and 311 or 453 and 853.
- MTHSC 826 Partial Differential Equations 3(3,0)**
First-order equations: elliptic, hyperbolic, and parabolic. Second-order equations: existence and uniqueness results, maximum principles, finite difference, and Hilbert Space methods. Offered fall semester only. *Preq:* MTHSC 821 or consent of instructor.
- MTHSC 827 Dynamical System Neural Networks 3(3,0)**
Modeling problems in the context of dynamical systems theory; useful methods from Lyapunov stability, local linearization, qualitative analysis using graph theory and numerical approximations; several dynamical systems neural networks including binary code recognizers and binary matrix choosers. *Preq:* MTHSC 206, 311.
- MTHSC 831 Fourier Series 3(3,0)**
Fourier series with applications to solution of boundary value problems in partial differential equations of physics and engineering. Introduction to Bessel functions and Legendre polynomials.
- MTHSC 837 Calculus of Variations and Optimal Control 3(3,0)**
Fundamental theory of the calculus of variations; variable end points; the parametric problem; the isoperimetric problem; constraint inequalities; introduction to the theory of optimal control; connections with the calculus of variations; geometric concepts. *Preq:* MTHSC 453 or 463.
- MTHSC 841 Applied Mathematics I 3(3,0)**
Derivation of equations from conservation laws, dimensional analysis, scaling and simplification; methods such as steepest descent, stationary phase, perturbation series, boundary layer theory, WKB theory, multiple-scale analysis, and ray theory applied to problems in diffusion processes, wave propagation, fluid dynamics, and mechanics. Offered fall semester only. *Preq:* MTHSC 208 and 453 or 463.
- MTHSC 850 Computational Algebraic Geometry 3(3,0)**
Covers algebraic geometry and commutative algebra via Grobner bases. Includes ideals and varieties (affine and projective), Grobner bases, elimination theory, dimensions, solving polynomial systems via eigenvalues and eigenvectors. Selected applications may include coding theory, computer vision, geometric theorem proving, integer programming, or statistics. *Preq:* MTHSC 311, 412.
- MTHSC 851 Abstract Algebra I 3(3,0)**
Basic algebraic structures: groups, rings, and fields; permutation groups, Sylow theorems, finite abelian groups, polynomial domains, factorization theory, and elementary field theory. Offered spring semester only.

- MTHSC 852 Abstract Algebra II 3(3,0)** Continuation of MTHSC 851 including selected topics from ring theory and field theory. Offered fall semester only.
- MTHSC 853 Matrix Analysis 3(3,0)** Topics in matrix analysis that support an applied curriculum: similarity and eigenvalues; Hermitian and normal matrices; canonical forms; norms; eigenvalue localizations; singular value decompositions; definite matrices. *Preq:* MTHSC 311, 453 or 463.
- MTHSC 854 Theory of Graphs 3(3,0)** Connectedness; path problems; trees; matching theorems; directed graphs; fundamental numbers of the theory of graphs; groups and graphs. Offered spring semester only. *Preq:* Consent of instructor.
- MTHSC 855 Combinatorial Analysis 3(3,0)** Combinations; permutations; permutations with restricted position; Polya's theorem; principle of inclusion and exclusion; partitions; recurrence relations; generating functions; Mobius inversion; enumeration techniques; Ramsey numbers; finite projective and affine geometries; Latin rectangles; orthogonal arrays; block designs; error detecting and error correcting codes. Offered fall semester only. *Preq:* MTHSC 311.
- MTHSC 856 Theory of Error-Correcting Codes 3(3,0)** Topics include code constructions such as Hamming, cyclic, BCH, Reed-Solomon, Goppa, algebraic geometry, finite geometry, low-density parity check, convolutional and polynomial codes; code parameters and bounds; and decoding algorithms. *Preq:* MTHSC 853 or consent of instructor.
- MTHSC 857 Cryptography 3(3,0)** Classical and modern cryptography and their uses in modern communication systems are covered. Topics include entropy, Shannon's perfect secrecy theorem, Advanced Encryption Standard (AES), integer factorization, RSA cryptosystem, discrete logarithm problem, Diffie-Hellman key exchange, digital signatures, elliptic curve cryptosystems, hash functions, and identification schemes. *Preq:* MTHSC 311, 400 or 600, 412 or 851.
- MTHSC 858 Number Theory 3(3,0)** Covers topics and techniques from modern number theory including unique factorization, elementary estimates on the distribution of prime numbers, congruences, Chinese remainder theorem, primitive roots, n -th powers modulo an integer, quadratic residues, quadratic reciprocity, quadratic characters, Gauss sums, and finite fields. *Preq:* MTHSC 853 or consent of instructor.
- MTHSC 860 Introduction to Scientific Computing 3(3,0)** Floating point models, conditioning and numerical stability, numerical linear algebra, integration, systems of ordinary differential equations and zero finding; emphasis is on the use of existing scientific software. *Preq:* CP SC 110, MTHSC 208, 311.
- MTHSC 861 Advanced Numerical Analysis I 3(3,0)** Consideration of topics in numerical linear algebra: eigenvalue problems, the singular value decomposition, iterative algorithms for solving linear systems, sensitivity of linear systems, and optimization algorithms. *Preq:* MTHSC 311 and 460; or 860.
- MTHSC 863 Digital Models I 3(3,0)** Experimental mathematics; pseudostochastic processes; analytical and algebraic formulations of time-independent simulation; continuous-time simulation and discrete-time simulation; digital optimization; Fibonacci search; ravine search; gradient methods; current research in digital analysis. Offered fall semester only. *Preq:* MTHSC 311, 453, digital computer experience.
- MTHSC 865 Data Structures 3(3,0)** Representation and transformation of information; formal description of processes and data structures; tree and list structures; pushdown stacks; string and formula manipulation; hashing techniques; interrelation between data structure and program structure; storage allocation methods. Offered fall semester only. *Preq:* Computational maturity, consent of instructor.
- MTHSC 866 Finite Element Method 3(3,0)** Discusses the basic theory of the finite element method (FEM) for the numerical approximation of partial differential equations. Topics include Sobolev spaces, interpolation theory, finite element spaces, error estimation, and implementation of FEM in one and higher dimensions. *Preq:* MTHSC 860 or consent of instructor.
- MTHSC 881 Mathematical Statistics 3(3,0)** Fundamental concepts of sufficiency, hypothesis testing and estimation; robust estimation; resampling (jackknife, bootstrap, etc.) methods; asymptotic theory; two-stage and sequential sampling problems; ranking and selection procedures. Offered spring semester only. *Preq:* MTHSC 403 or equivalent.
- MTHSC 884 Statistics for Experimenters 3(3,0)** Statistical methods for students who are conducting experiments; introduction to descriptive statistics, estimation, and hypothesis testing as they relate to design of experiments; higher-order layouts, factorial and fractional factorial designs, and response surface models. Offered fall semester only. *Preq:* MTHSC 206 or equivalent.
- MTHSC 885 Advanced Data Analysis 3(3,0)** Continuation of MTHSC 805 covering alternatives to ordinary least squares, influence and diagnostic considerations, robustness, special statistical computation methods. Offered spring semester only. *Preq:* MTHSC 603, 800, 805.
- MTHSC 891 Master's Thesis Research 1-12**
- MTHSC 892 Master's Project Course 1(0,1)** For students in the nonthesis option of the MS degree program in Mathematical Sciences. Successful completion includes a presentation of the master's project to the student's advisory committee and acceptance of the paper by the committee.
- MTHSC 900 Seminar in Preparing for College Teaching in the Mathematical Sciences 3(3,0)** Elements involved in being a college professor with emphasis on broadening the student's mathematical experiences within a framework of improving classroom performance. *Preq:* Completion of the departmental PhD qualifying examinations.
- MTHSC 901 Probability Theory I 3(3,0)** Axiomatic theory of probability; distribution functions; expectation; Cartesian product of infinitely many probability spaces, and the Kolmogorov consistency theorem; models of convergence; weak and strong laws of large numbers. *Preq:* MTHSC 400 and 822, or MTHSC 800 and 822 or consent of instructor.
- MTHSC 902 Probability Theory II 3(3,0)** Continuation of MTHSC 901; characteristic functions, infinitely divisible distributions, central limit theorems, laws of large numbers, conditioning, and limit properties of sums of dependent random variables, conditioning, martingales. *Preq:* MTHSC 901.
- MTHSC 927 Functional Analysis 3(3,0)** Linear operators on specific spaces, spectral theory, semigroups of operators and the Hille-Yosida theorem, applications of linear spaces and operators, convexity. *Preq:* MTHSC 821.
- MTHSC 954 Advanced Graph Theory 3(3,0)** Continuation of MTHSC 854 including the four-color theorem, domination numbers, Ramsey theory, graph isomorphism, embeddings, algebraic graph theory, and tournaments. Research papers are also examined. Offered fall semester only. *Preq:* MTHSC 854 or consent of instructor.
- MTHSC 970 Directed Studies in Mathematical Sciences 1-3(1-3,0)** Directed individual studies on topics in the mathematical sciences supervised by faculty. May be repeated for a maximum of 18 credits. *Preq:* Consent of instructor.
- MTHSC 974 Selected Topics in Mathematical Sciences 3(3,0)** Advanced topics in the mathematical sciences from current areas of interest presented in lecture format. May be repeated for a maximum 24 credits, but only if different topics are covered. *Preq:* Consent of instructor.
- MTHSC 981 Selected Topics in Mathematical Statistics and Probability 1-3(1-3,0)** Advanced topics in mathematical statistics and probability of current interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 982 Selected Topics in Analysis 1-3(1-3,0)** Advanced analysis topics from current problems of interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 983 Selected Topics in Computational Mathematics 1-3(1-3,0)** Advanced topics in computational mathematics and numerical analysis from current problems of interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 985 Selected Topics in Algebra and Combinatorics 1-3(1-3,0)** Advanced topics in algebra and combinatorics from current problems of interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 986 Selected Topics in Geometry 1-3(1-3,0)** Advanced topics in geometry from current problems of interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 988 Selected Topics in Operations Research 1-3(1-3,0)** Advanced topics in operations research from current problems of interest. May be repeated for credit, but only if different topics are covered.

MTHSC 989 Selected Topics in Mathematical Education 3(3,0) Advanced topics in the mathematical sciences from the area of mathematics education. May be repeated for credit, but only if different topics are covered. *Preq:* Consent of instructor.

MTHSC 991 Doctoral Dissertation Research 1-12

MECHANICAL ENGINEERING

M E 607 Applied Heat Transfer 3(3,0) Application-oriented extension of M E 304 considering topics in transient conduction, flow of fluids, energy exchange by radiation, and mass transfer. Applications in heat-exchanger design with emphasis on economics and variation of operating conditions from the design point. *Preq:* M E 304, consent of instructor.

M E 616 Control of Mechanical Systems 3(3,0) Physical modeling and feedback principles are presented for control of mechanical systems. Transient response, root locus, and frequency response principles are applied to the control of basic mechanical systems such as electric motors, fluid tanks, or thermal processes. PID control laws are emphasized. *Preq:* M E 305.

M E 617 Mechatronics System Design 3(2,3) Mechatronics integrates control, sensors, actuators, and computers to create a variety of electromechanical products. Includes concepts of design, appropriate dynamic system modeling, analysis, sensors, actuating devices, and real-time microprocessor interfacing and control. Laboratory experiments, simulation, and design projects are used to exemplify course concepts. *Preq:* M E 305 or consent of instructor.

M E 620 Energy Sources and Their Utilization 3(3,0) Covers availability and use of energy sources such as fossil fuels, solar (direct and indirect), and nuclear. Addresses energy density and constraints to use (technical and economic) for each source. *Preq:* M E 303, 304.

M E 621 Introduction to Compressible Flow 3(3,0) Introductory concepts to compressible flow; methods of treating one-dimensional gas dynamics including flow in nozzles and diffusers, normal shocks, moving and oblique shocks, Prandtl-Meyer Flow, Fanno Flow, Rayleigh Flow, and reaction propulsion systems. *Preq:* M E 303, 308.

M E 622 Design of Gas Turbines 3(3,0) Guiding principles in gas turbine cycles are reviewed. Turbine and compressor design procedures and performance prediction for both axial and radial flow machines are presented. Methods of design of rotary heat-exchangers and retrofitting gas turbine for regenerative operation are presented. Design projects are used to illustrate the procedures. *Preq:* M E 308.

M E 623 Introduction to Aerodynamics 3(3,0) Basic theories of aerodynamics for accurately predicting the aerodynamic forces and moments which act on a vehicle in flight. *Preq:* M E 308.

M E 629 Thermal Environmental Control 3(3,0) Mechanical vapor compression refrigeration cycles, refrigerants, thermoelectrical cooling systems, cryogenics, thermodynamic properties of air, psychometric charts, heating and cooling coils, solar radiation, heating and cooling loads, insulation systems. *Preq:* M E 303, 308.

M E 630 Mechanics of Composite Materials 3(3,0) Fundamental relationships for predicting the mechanical and thermal response of multilayered materials and structures are developed. Micromechanical and macromechanical relationships are developed for laminated materials with emphasis on continuous filament composites. The unique nature of composites and the advantages of designing with composites are discussed. *Preq:* M E 302.

M E 632 Advanced Strength of Materials 3(3,0) Topics in strength of materials not covered in M E 302. Three-dimensional stress and strain transformations, theories of failure, shear center, unsymmetrical bending, curved beams, and energy methods. Other topics such as stress concentrations and fatigue concepts are treated as time permits. *Preq:* M E 302.

M E 650 Mechanical Vibrations 3(3,0) Mathematical analysis of physical problems in the vibration of mechanical systems. Topics include linear-free vibrations, forced vibrations, and damping in single degree of freedom systems, transient vibrations, critical speeds and whirling of rotating shafts, dynamic balancing, and multidegree of freedom systems with lumped parameters. *Preq:* E M 202, M E 302, MTHSC 208.

M E 653 Dynamic Performance of Vehicles 3(3,0) Introduces techniques for analyzing the dynamic behavior of vehicles such as aircraft, surface ships, automobiles and trucks, railway vehicles, and magnetically levitated vehicles. *Preq:* M E 205, 305, or consent of instructor.

M E 654 Design of Machine Elements 3(3,0) Design of common machine elements including clutches, brakes, bearings, springs, and gears. Optimization techniques and numerical methods are employed as appropriate. *Preq:* M E 306 or consent of instructor.

M E 655 Design for Computer-Automated Manufacturing 3(3,0) Concepts of product and process design for automated manufacturing. Topics include product design for automated manufacturing, inspection and assembly using automation, industrial robots, knowledge-based systems, and concepts of flexible product manufacture. *Preq:* M E 301, 306, 404 (or concurrent enrollment) or consent of instructor.

M E (C E) 656 Fundamentals of Robotics 3(3,0) Introduction to the fundamental mechanics and control of robots including their application to advanced automation. Topics include robot geometry, kinematics, dynamics, and control. Planar machine structures are emphasized, including methods using computer analysis. Application considerations include design and operation of robot systems for manufacturing and telerobotics. *Preq:* M E 305, 416 (or concurrent enrollment), or consent of instructor.

M E 671 Computer-Aided Engineering Analysis and Design 3(2,3) Students are exposed to geometric and solid modeling, finite elements, optimization, and rapid-prototyping. Students design an artifact, represent it on the computer, analyze it using FEA, then optimize before prototyping it. Emphasizes the use of computer-based tools for engineering design. *Preq:* ENGR 141, M E 202, or consent of instructor.

M E 693 Selected Topics in Mechanical Engineering 1-6(1-6,0) Study of topics not found in other courses. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

M E 801 Foundations of Fluid Mechanics 3(3,0) Derivations of basic equations for multidimensional flow fields; analytical techniques for solving problems in laminar viscous flow and laminar inviscid flow; theories of similitude. *Preq:* Consent of instructor.

M E 810 Macroscopic Thermodynamics 3(3,0) First, second, and third laws of thermodynamics with engineering applications; thermodynamic property relations; chemical equilibrium. *Preq:* M E 312 or equivalent.

M E 811 Gas Dynamics 3(3,0) Concepts from thermodynamics, one-dimensional gas dynamics, one-dimensional wave motion, normal, and oblique shocks; flow in ducts and wind tunnels; two-dimensional equation of motion; small perturbation theory. *Preq:* Undergraduate course in fluid mechanics.

M E 812 Experimental Methods in Thermal Science 3(2,2) Theories of measurements, instrumentation, and techniques for measuring temperature, pressure, and velocity on a practical graduate engineering level; mathematical presentation of data, uncertainty analysis, data acquisition techniques, and theory and state-of-the-art measuring systems.

M E 814 Concepts of Turbulent Flow 3(3,0) Concepts of fluid turbulence; turbulent transport mechanisms, dynamics of turbulence, and experimental techniques pertinent to existing theories; classification of shear flows and their prediction methods. *Preq:* M E 801.

M E (PHYS) 815 Statistical Thermodynamics I 3(3,0) See PHYS 815.

M E 818 Introduction to Finite Element Analysis 3(3,0) Introduction to the finite element method; applications to heat transfer, fluid flow and solids; introduction to transient analysis; analysis strategies using finite elements; introduction to solid modeling, finite element modeling and analysis using commercial codes. *Preq:* Numerical methods course or consent of instructor.

M E 819 Computational Methods in Thermal Sciences 3(3,0) Numerical techniques as applied to the solution of fluid flow and heat transfer problems; use of finite difference methods.

M E 820 Modern Control Engineering 3(3,0) Mathematical modeling of engineering systems using differential and difference state equations; state variable time solutions using analytic and computer-aided analysis techniques; state control principles of controllability, observability, stability and performance specification; trade-offs between state variable and transfer function techniques. *Preq:* Undergraduate controls course or consent of instructor.

M E 821 Advanced Control Engineering 3(3,0) Concepts in multivariable, nonlinear, stochastic, and optimal control engineering; design and analysis considerations related to physical machines and processes; mathematical methods as needed. *Preq:* Undergraduate controls course or consent of instructor.

M E 829 Energy Methods and Variational Principles 3(3,0) Application of variational principles in solid mechanics problems; virtual work; Castigliano's theorems on deflection and rotation; stationary potential energy; energy stability criterion; Hamilton's principle. *Preq:* M E 837 or consent of instructor.

M E 830 Conduction and Radiation Heat Transfer 3(3,0) Fundamental concepts related to conduction and radiation heat transfer; analytical methods for steady and transient conduction heat transfer in one and two physical dimensions; radiation exchange between surfaces with and without radiatively participating media; combined conduction and radiation heat transfer. *Preq:* M E 304 or equivalent.

M E 831 Convective Heat Transfer 3(3,0) Derivation of continuity, momentum, and energy equations for boundary layer flow; solutions for confined and external flow regimes in laminar and turbulent flow. *Preq:* M E 304 or equivalent, MTHSC 208.

M E 832 Radiative Heat Transfer 3(3,0) Radiation properties; enclosure theory; radiation exchange between solid bodies; radiation exchange in the presence of absorbing, transmitting, and emitting media; combined radiation, conduction, and convection exchange. *Preq:* M E 304 or equivalent, consent of instructor.

M E 833 Heat Transfer with Change of Phase 3(3,0) Nucleate boiling in a pool; film boiling in a pool; forced nucleate boiling; forced film boiling; effect of impurities on boiling phenomena; dropwise condensation; filmwise condensation; effect of noncondensable gases on condensation; boiling and condensing processes in systems. *Preq:* M E 304 or equivalent, consent of instructor.

M E 834 Principles of Structural Stability 3(3,0) Practical criteria for analysis of conservative and nonconservative systems' stability; methods of adjacent equilibrium, initial imperfections, total potential energy, and vibration as applied to practical problems. *Preq:* M E 837.

M E 836 Fracture Mechanics 3(3,0) Fundamental elasticity-based course in the development of the basic concepts of engineering fracture mechanics; the Griffith criterion, Barrenblatt and Dugdale models, linear elastic fracture mechanics (L.E.F.M.), plane strain fracture toughness, the crack-tip stress and strain field, and plasticity and the J-integral. *Preq:* M E 837.

M E 837 Theory of Elasticity I 3(3,0) Theory of stress and deformation for continuous media; linear stress-strain relations for elastic material; two-dimensional problems including Airy stress function, polynomial solutions, plane stress and plane strain in rectangular and polar coordinates, torsion and bending of prismatic bars and thermal stresses. *Preq:* M E 302, MTHSC 208.

M E 838 Theory of Elasticity II 3(3,0) Continuation of M E 837 including topics from either three-dimensional problems associated with an infinite elastic medium, elastic half-space, contact stresses, symmetrically loaded sphere and circular cylinder, or complex variable methods in plane elasticity, stress concentrations problems, singular stresses and fracture, and composite materials. *Preq:* M E 837, PHYS 812.

M E 843 Nonlinear Dynamics of Mechanical Systems 3(3,0) Behavior of nonlinear mechanical systems analyzed with numerical, graphical, and analytical methods; understanding nonlinear effects and methods of analysis. *Preq:* Graduate standing or consent of instructor.

M E 845 Vibration of Continuous Media 3(3,0) Fundamental principles of generation, propagation, absorption, reflection, and scattering of vibrational wave in solids and fluids; free and forced oscillation of flexible strings, bars, membranes, and plates; theory of wave motion in liquids and gases. *Preq:* Consent of instructor.

M E 846 Intermediate Dynamics 3(3,0) Kinematics and dynamics of particles and rigid bodies, Lagrange and Hamilton's formulation of mechanics; two-body central force problem; rendezvous of two bodies in a central force field; rotation of rigid bodies about a fixed point in space; vector analysis and matrix methods as aids in mathematical analysis. *Preq:* E M 202 or consent of instructor.

M E 852 Advanced Finite Element Analysis 3(3,0) Application of variational and weighted residuals methods; nonlinear analysis, steady-state, and time-dependent problems; application of commercial finite element codes; advanced computational procedures. *Preq:* C E 808 or equivalent or consent of instructor.

M E (E C E) 859 Intelligent Robotic Systems 3(3,0) See E C E 859.

M E 861 Materials Selection in Engineering Design 3(3,0) Advanced study of various physical, chemical, and mechanical materials properties which govern the selection of materials in engineering design. Case studies of materials selection in design with metals, ceramics, polymers, and composites are presented.

M E 870 Advanced Design Methodologies 3(3,0) Nurturing of creativity; decision-making processes for design; in-depth study of the mechanical design process and tools; quality function deployment, concurrent design, systemic design, robust design, design for assembly, and axiomatic design.

M E 871 Engineering Optimization 3(3,0) Optimization in the context of engineering design; nonlinear and linear, static and dynamic, constrained and unconstrained formulation and solution of practical problems; structural optimization; multiobjective optimization; genetic algorithms; simulated annealing.

M E 891 Master's Thesis Research 1-12

M E 893 Selected Topics in Mechanical Engineering 1-6(1-6,0) Topics not covered in other courses. May be repeated for credit.

M E 930 Advanced Topics in Heat Transfer 1-6(1-6,0) Topics not covered in other courses. May be repeated for a maximum of six credits.

M E 931 Advanced Topics in Fluid Mechanics 3(3,0) Topics not covered in other courses. May be repeated for a maximum of six credits.

M E 932 Advanced Topics in Thermodynamics 3(3,0) Topics not covered in other courses. May be repeated for a maximum of six credits.

M E 991 Doctoral Dissertation Research 1-12

MICROBIOLOGY

MICRO 600 Public Health Microbiology 3(3,0) Epidemiology of transmissible diseases including pathogenic characteristics of the infectious organism, modes of transmission, mechanism of infection, diagnostic aids, effective treatments, immunizing procedures, and methods of preventing infection. *Preq:* MICRO 305.

MICRO 601 Microbial Diversity and Ecology 4(2,6) In-depth survey of microbial morphology, ecology, and diversity. Study of the interaction and adaptation of microbes in a wide range of environmental conditions, including consideration of their metabolism, nutrition, growth, and the use of microbiological assays. *Preq:* CH 201 or 223, 227, MICRO 305.

MICRO 602 Environmental Microbiology 3(3,0) Discussion of microorganisms in air, terrestrial, and aquatic environments and how they are used for environmental restoration activities. Topics include the nature of biofilms, interactions of microbes with inorganic and organic constituents, processes to implement bioremediation in surface/subsurface environments, and treatment of solid, liquid, and gaseous waster streams. *Preq:* MICRO 305, 401, one semester of organic chemistry, or consent of instructor.

MICRO 603 Marine Microbiology 3(2,3) Discussion of the microbes that inhabit the marine environment, their peculiar physiological traits, and contributions to the ecology of oceans. *Preq:* MICRO 305, organic chemistry.

MICRO 607 Food and Dairy Microbiology 4(3,3) Physical-chemical factors limiting survival and growth of microorganisms during processing and manufacturing of food and dairy products. Standard methods for enumerating and identifying indicator bacteria, yeasts, molds, and microbes producing food and food-borne illness. Starter cultures, fungal toxins, microbial cell injury, and standards for food and dairy products. *Preq:* BIOCH 305 or CH 201 or 223, MICRO 305.

MICRO 610 Soil Microbiology 3(2,3) Role of microorganisms in the decomposition of organic substances, transformation of nitrogen, and mineral substances in the soil; interrelationships between higher plants and microorganisms; importance of microorganisms in soil fertility. *Preq:* MICRO 305.

MICRO 611 Pathogenic Bacteriology 4(3,3)

Study of pathogenic bacteria and their virulence mechanisms. Emphasizes host-microbe interactions, responses to infection and treatment, and research strategies for various topics of bacterial pathogenesis. *Preq:* MICRO 305, 414.

MICRO 612 Bacterial Physiology 4(3,3)

Considers the cytology, physiology, metabolism, and genetics of bacteria including growth and death, reproduction and mutation, nutrition and metabolic pathways, regulatory mechanisms, and effects of environment. *Preq:* CH 224, MICRO 305, one semester of biochemistry, or consent of instructor.

MICRO 613 Industrial Microbiology 3(2,3)

Microbial aspects of large-scale processes for the production of foods, antibiotics, enzymes, fine chemicals, and beverages. Topics include strain selection, culture maintenance, biosynthetic pathways, continuous cultivation, and production of single cell protein. *Preq:* MICRO 305.

MICRO (AVS, BIOSC) 614 Basic Immunology 4(3,3)

Consideration of the nature, production, and function of basic immune responses in animals. Procedures and mechanisms of antigen-antibody and other immune reactions. *Preq:* MICRO 305, organic chemistry.

MICRO 615 Microbial Genetics 4(3,3)

Cytological basis of bacterial, fungal, and viral genetics; molecular aspects; mutations; mechanisms of genetic transfers; episomes and plasmids; and population changes. *Preq:* BIOCH 301, MICRO 305, 412.

MICRO 616 Introductory Virology 3(3,0)

General introduction to the field of virology including animal, bacterial, and plant viruses. Topics include nomenclature and classification, biochemical and biophysical characteristics, mechanisms of replication, chemotherapy, and techniques for isolation, assay, and purification. *Preq:* BIOCH 301, MICRO 305, or consent of instructor.

MICRO 617 Molecular Mechanisms of Carcinogenesis and Aging 3(3,0)

Changes which occur at the cellular and subcellular levels during transformation and aging. Accumulated damage and "intrinsic clock" theories of aging; genetic and epigenetic theories of carcinogenesis; epidemiology of cancer; viral, radiation-induced, and chemical carcinogenesis; the immune system and cancer. *Preq:* BIOCH 301, MICRO 305, or consent of instructor.

MICRO (BIOSC, GEN) 618 Biotechnology I: Nucleic Acids Techniques 4(2,4)

See GEN 618.

MICRO 619 Selected Topics in Molecular Medicine 3(3,0)

Introduction to various areas of molecular medicine. Examines the latest research and developments in molecular medicine. Designed for students interested in medicine and biomedical research. May be repeated for a maximum of six credits. *Preq:* BIOCH 301, MICRO 305, or consent of instructor.

MICRO 802 Bacteriological Techniques 4(2,6)

Analytical and experimental procedures used in bacteriology including techniques for studying bacterial cytology, physiology, and metabolism; experience in more advanced methods of investigation. Offered fall semester only.

MICRO 803 Special Problems in Microbiology 1-3

Research not related to a thesis.

MICRO 804 Selected Topics in Microbiology 1-3(1-3,0)

Evaluation of current research literature in various areas of microbiology. Critical evaluation of specific publications in terms of their scientific merit. Required of all Microbiology graduate students. May be repeated for credit.

MICRO 805 Techniques of Clinical Microbiology and Immunobiology 3(2,3)

Methods for isolating, identifying, and culturing different mammalian cell types; techniques used to analyze cell function and viability and for protein and DNA analysis emphasizing application to the diagnosis of disease, determination of prognosis, optimization of treatment, and determination of etiology. *Preq:* MICRO (AVS, BIOSC) 614, 615, BIOCH 623 or equivalent, or consent of instructor.

MICRO 806 Pathogenesis and Infectious Disease 3(3,0)

Medically important host-parasite relationships at the cellular and subcellular levels with emphasis on bacterial and viral infections in man. *Preq:* MICRO 611 or consent of instructor.

MICRO 807 Current Topics in Microbiology 1(1,0)

Students learn and practice skills of literature interpretation, presentation, and discussion of articles in relevant and current scientific journals. May be repeated for a maximum of eight credits.

MICRO (HLTH) 809 Epidemiological Research 3(3,0)

Basic concepts of epidemiology with emphasis on applied aspects rather than theoretical. Examples are drawn from clinical practice. Use of relevant PC-based computer packages is required. *Preq:* MTHSC 405 or EX ST 801 or consent of instructor.

MICRO 811 Bacterial Cytology and Physiology 4(4,0)

Structure, chemistry, and physiology of the various bacterial cell components. Physiology of bacterial growth and reproduction in batch, continuous, and synchronous cultures. Economy of the bacterial cell including endogenous metabolism and maintenance requirements; physiology of bacterial death; regulation of enzyme and nucleic acids syntheses. Offered spring semester of odd-numbered years only. *Preq:* BIOCH 423, MTHSC 206, or consent of instructor.

MICRO 812 Bacterial Metabolism 3(3,0)

Various biochemical pathways occurring in bacterial cells; fermentations of carbohydrates and related compounds and of nitrogenous organic compounds; anaerobic and aerobic respiration including electron transport systems and oxidative phosphorylation; bacterial photosynthesis; nitrogen fixation; biosyntheses of amino acids, purines, pyrimidines, lipids, proteins, nucleic acids, and polysaccharides. Offered spring semester of even-numbered years only. *Preq:* BIOCH 423, MTHSC 206, or consent of instructor.

MICRO 815 Advanced Microbial Genetics 3(3,0)

Current developments in microbial genetics; integration of genetics and biochemistry; analysis of genetic fine structure in microorganisms; nature of bacterial variation and expression of mutations; population dynamics; physicochemical mechanisms of heredity; regulation of gene action in microorganisms; physiology and genetics of virulent and lysogenic bacteriophages. Offered fall semester only. *Preq:* MICRO 415.

MICRO 891 Master's Thesis Research 1-12**MICRO 991 Doctoral Dissertation Research 1-12****MUSIC****MUSIC 600 Elementary Music in the Classroom 3(3,0)**

Familiarizes teachers in the elementary classroom with traditional Kodaly, Orff, and Kindermusik approaches in correlating music with language arts, mathematics, and social studies.

MUSIC 680 Audio Engineering II 3(2,2)

Advanced course in music technology focused on music production integrating digital audio and virtual instruments *Preq:* MUSIC 380 or consent of instructor.

MUSIC 699 Independent Studies 1-3(1-3,0)

Tutorial work for students with special interests in music study outside the scope of existing courses. May be repeated for a maximum of six credits. *Preq:* Consent of department chair.

NURSING**NURS 801 Advanced Family and Community Nursing 3(3,0)**

Developmental, psychodynamic, social-political, and cultural theories and concepts are synthesized and applied to the analysis of health and illness in communities and in families across the life cycle. Roles and functions of advanced practice nurses in promoting community health and family health are examined.

NURS 804 Knowledge Development in Advanced Nursing 2(2,0)

Nursing theories and theories relevant to nursing practice and research; processes of theoretical thinking and critical thinking applied to health problems and needs of individuals and their families in the community; theoretical and conceptual models of contemporary practice and research.

NURS 805 Pharmacotherapeutics for Advanced Nursing 3(3,0)

Prescription administration and patient/family education in use of pharmacological agents emphasizing drugs prescribed for common or chronic illnesses; drug selection; adverse drug reactions; age-related differences in utilization; regulations affecting nurses' prescriptive authority. *Preq:* NURS 809 or consent of instructor.

NURS 806 Advanced Assessment for Nursing 2(1,3)

Comprehensive assessment and diagnosis of health problems and status for individuals of all ages including assessment of families; physical and laboratory/radiologic diagnostic assessments; directed laboratory experiences in advanced assessment of clients of several ages. *Preq:* Undergraduate assessment and NURS 809 or consent of instructor.

NURS 807 Clinical Nursing Research 2(2,0)

Quantitative and qualitative research methodologies useful and appropriate to clinical nursing practice and for the development of nursing knowledge; ethics with human subjects; does not include thesis advisement. Student must select chairperson prior to enrollment. *Preq:* NURS 804, 808.

NURS 808 Nursing Research Analysis 2(2,0)

Quantitative research methods in nursing science including basic elements of statistical design with a focus on the use of nursing informatics and computer applications. *Preq:* Undergraduate statistics course.

- NURS 809 Pathophysiology for Advanced Nursing 3(3,0)** Human response to health alterations as they impact nursing knowledge and practice; recognizing the manifestations of health alterations and developing nursing interventions accordingly.
- NURS 814 Instructional Technologies for Nursing Educators 3(3,0)** Provides novice and experienced nurse educators an opportunity to integrate emerging instructional technologies. Covers theories and trends that support the use of technologies for the enhancement of teaching and learning. Emphasizes the integration of education technologies and the evaluation of current technologies to enhance instruction.
- NURS 819 Developing Family Nursing 4(2,6)** Theories and concepts related to nursing management in the care of developing families; critical thinking applied to health problems and needs of developing families before, during, and immediately following pregnancy; application of related nursing issues and current research; clinical practice with developing families in a variety of settings. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 820 Child and Adolescent Nursing 4(2,6)** Advanced nursing roles and functions applied to health promotion, health maintenance, health restoration, habilitation, and rehabilitation of infants, children, and adolescents with existing or potential health problems. Critical thinking is used to assess, diagnose, intervene, and promote continuity of care with clients of these ages irrespective of setting. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 821 Adult Nursing 4(2,6)** Roles and functions embodied in advanced practice applied to the health promotion and clinical management of common or chronic health problems of adults within the context of family; clinical practice with adult clients in a variety of settings. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 822 Gerontology Nursing 4(2,6)** Roles and functions of advanced practice applied to the preventive, restorative, and rehabilitative care of the older adult with existing or potential health problems; clinical practice in a variety of settings. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 823 Nurse Practitioner Clinical Practicum 6(0,18)** Guided practice applying advanced nursing knowledge in family nursing and advanced practice roles (clinical nurse specialist, case manager, and/or practitioner); joint preceptor and faculty guidance and supervision in the care of selected populations in a variety of health care settings. *Preq:* FNP track: NURS 819, 820, 821, 822; GNP track: NURS 822, 882, 884; A/GNP track: NURS 821, 822, 882, 884.
- NURS 825 Leadership in Health-Care Systems 3(3,0)** Examines health-care systems and delivery across the continuum. Emphasizes complexity, influence of internal and external environments, assessment of strengths and opportunities, strategic planning, leadership theories, and leading change. Explores implications for middle and executive level health-care leaders. *Preq:* NURS 804 or consent of instructor.
- NURS 826 Quality and Outcomes Management in Health Care 4(3,3)** Examines the science of systems improvement including the models, methods, and tools of process analysis and improvement applied to health care. Emphasis is on designing outcome and evidence-based safe and efficient processes and workflows to achieve customer satisfaction and targeted outcomes. Practicum with quality experts permits guided application of classroom content. *Preq:* NURS 825 or consent of instructor.
- NURS 827 Foundations of Nursing Education 3(3,0)** Exploration of the foundations of nursing education. Emphasizes curriculum development in nursing for the collegiate or continuing education areas. Current issues and research that influence nursing education. *Preq:* Graduate standing in Nursing.
- NURS 828 The Nurse Educator 3(2,3)** Roles and functions of nurse educators applied to education of nurses and nursing students in collegiate and continuing education nursing education programs; current issues and research in classroom, laboratory, and continuing education programs. A teaching practicum is required. *Preq:* NURS 827 or consent of instructor.
- NURS 829 Theories and Models of Clinical Specialization 3(3,0)** Caregiver, researcher, manager, teacher, and consultant roles of the clinical nurse specialist in a variety of settings; theories, models, and health care issues underlying the role of clinical nurse specialist. *Preq:* NURS 804, CNS graduate option, or consent of instructor.
- NURS 830 Clinical Specialty Practicum in Nursing 6(0,18)** Advanced practice in a selected clinical specialty area in nursing that emphasizes application of the clinical specialist role. *Preq:* NURS 829 and one of the following: NURS 819, 820, 821, 822, 882, 884, or consent of instructor.
- NURS 831 Clinical Research Problems 1-3(1-3,0)** Critical thinking and methodologies of scientific inquiry applied to clinical issues/problems encountered in advanced nursing practice. May be repeated for a maximum of three credits. To be taken Pass/Fail basis. *Preq:* NURS 804.
- NURS 846 Healthcare Financial Management 3(3,0)** Analysis of financial theory and practice for healthcare executives. Includes methods of financial reporting and defines accounting practices for decision making and operating activities. Includes processes for measuring and reporting financial information, analysis, interpretation, and use of financial information for planning and controlling the health-care business. *Preq:* Undergraduate accounting.
- NURS 847 Internship 3(1,6)** Guided practice to apply advanced nursing knowledge in nursing administration in the advanced practice role; joint preceptor and faculty guidance and supervision in the administrative management and care with selected populations in a variety of health care settings. *Preq:* NURS 825, 826, 846, or consent of instructor.
- NURS 848 Health Care Policy and Economics 3(3,0)** Reciprocal relationship between client, community, health care system, sociocultural, and economic variables and policy making; analysis and synthesis of these relationships and their impact on the role and responsibility of the advanced practice nurse and nurse administrator. *Preq:* Graduate standing or consent of instructor.
- NURS 850 Information and Control Systems for Nursing Leadership 3(3,0)** Computer-based systems of information management and control for nursing environments. Explores data needed for cost-efficient use of nursing resources and effective systems of monitoring, quality assurance, and control; information systems as tools useful to humanistic nursing practice, human resource management, and solution of professional and scientific problems. *Preq:* Graduate standing or consent of instructor.
- NURS 879 Special Topics in Nursing 1-3(1-3,0-9)** In-depth seminar on selected topics such as therapeutic communication, legal and ethical issues in nursing, and health care and political process in health. *Preq:* Consent of instructor.
- NURS 882 Primary Care for Elders 4(2,6)** Application of the roles and functions of advanced practice in the management of frailty in old age; prevention of early disability and dependence; maintenance of function, independence, and self care; cultural, social, and ethical issues. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 884 Mental Health and Illness of Adults 4(2,6)** Psychosocial, developmental, spiritual, and cultural theories are synthesized and applied to the analysis of mental health and illness in adulthood. Considers roles and functions of advanced practice nurses in promoting the mental health of adults and their families. Clinical practice in the community is incorporated. *Preq:* NURS 801, 804, 805, 806, 809.
- NURS 889 Special Problems in Nursing 1-6(1-6,0)** Problems selected to meet special and individualized interests of students. Up to six hours of NURS 889 may be taken as elective credit. *Preq:* Consent of instructor.
- NURS 891 Master's Thesis Research 1-12** Research activities related to thesis; minimum of six hours required. *Preq:* NURS 804.
- NURS 901 Advances in Human Genetics 3(3,0)** Overview of the disciplines and content areas related to advances in human genetics/genomics. Topics include aspects of biochemical, molecular, population genetics and cytogenetics as they relate to genomic health care Bioinformatics is addressed, incorporating the use of genetic databases for research and clinical settings.
- NURS 903 Interdisciplinary Research 1(1,0)** Examination of interdisciplinary research in the life sciences as a means of integrating information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance knowledge development or solve problems. *Preq:* Consent of instructor.

NURS 905 Genomics, Ethics, and Health Policy 3(3,0) Designed for health-care professionals. Analyzes relationships among political climate, policy design, and government action as related to ethical, legal, and social issues surrounding availability of genetic information. Examines an ethical perspective and outcomes on health policies relating to genomic issues as well as contemplated actions based on new medical techniques. *Preq:* Consent of instructor.

NUTRITION

NUTR 601 Fundamentals of Nutrition 3(3,0) Biochemical and physiological fundamentals of nutrition applicable to domestic animals and man. Digestive processes and absorption and metabolism of carbohydrates, lipids, proteins, water, minerals, and vitamins are considered. Energy metabolism and comparative anatomy and physiology of digestive systems are discussed. Offered fall semester only. *Preq:* BIOCH 305, CH 223, or consent of instructor.

NUTR 624 Medical Nutrition Therapy I 4(3,3) Principles of nutritional assessment, education, and counseling skills; development of medical nutrition therapy for individuals with obesity and eating disorders, gastrointestinal disorders, metabolic, and renal disorders. *Preq:* BIOSC 223, NUTR 451, or consent of instructor.

NUTR 625 Medical Nutrition Therapy II 4(3,3) Development of medical nutrition therapy for individuals with various disease states including cardiovascular, hepatic, musculoskeletal, and neoplastic disorders with consideration of socio-cultural and ethnic aspects of food consumption and alternative nutrition therapies. *Preq:* BIOSC 223, NUTR 424, or consent of instructor.

NUTR 626 Community Nutrition 3(3,0) Study of fundamentals of nutrition care delivery in community programs beginning with assessment and problem identification and continuing through the development, implementation, and evaluation of nutrition intervention programs. *Preq:* NUTR 451 or equivalent or consent of instructor.

NUTR 651 Human Nutrition 3(3,0) Essentials of nutrition and principal nutritional deficiency conditions. Factors affecting adequacy of dietary intake, methods of determining nutritional status, development of nutrition standards, and recent advances in human nutrition. *Preq:* BIOCH 305/306 or equivalent or consent of instructor.

NUTR 655 Nutrition and Metabolism 3(3,0) Concepts of metabolism fundamental to understanding normal and therapeutic nutrition are examined. Bioenergetics as well as metabolism of carbohydrates, lipids, amino acids, vitamins, and minerals as they relate to nutrition are discussed. *Preq:* BIOCH 305 or 406 or 423, NUTR 451, or consent of instructor.

NUTR 706 Nutrition for Teachers 3(3,0) Principles of nutrition applied to nutrition education. *Preq:* Consent of instructor.

NUTR 801 Topical Problems in Nutrition 1-3(1-3,0) Topics not covered in other courses or by thesis research. Credit varies with problems selected.

NUTR 802 Special Topics in Nutrition 1-3(1-3,0) Topics of special interest or contemporary subjects not examined in other courses.

NUTR 803 Advanced Human Nutrition 4(4,0) Biochemistry and physiology related to human nutrition and their application to formation and adoption of healthy eating patterns. Emphasis is on individual nutrients in the context of healthy eating patterns throughout the life cycle and on recent advances in human nutrition. *Preq:* BIOCH 305/306, BIOSC 223, NUTR 451, or consent of instructor.

NUTR 804 Nutrition Education of the Public 3(3,0) Analysis of community-based food and nutrition programs to include management, program provision, outcome-based evaluation, and integration of services. Emphasis is on outcome-based nutrition education across the lifespan, management and integration of multiple services for targeted population, and public policy development. *Preq:* NUTR 426 or consent of instructor.

NUTR 805 Metabolic Basis of Medical Nutrition Therapy 3(3,0) Integration of metabolism and pathophysiology into medical nutrition therapy recommendations. *Preq:* NUTR 425 or consent of instructor.

NUTR 806 Dietetic Internship 1-6(0,3-18) Internship consisting of preceptor-supervised and faculty-led dietetic experiences in community, clinical, and food service settings. Must be taken for six credits during the internship rotations. *Preq:* Acceptance into Dietetic Internship Program.

NUTR 808 Monogastric Nutrition 3(3,0) Basic concepts and current research related to nutrient requirement and metabolism of poultry, swine, and other monogastric species. *Preq:* NUTR 401 or 451.

NUTR 809 Ruminant Nutrition 3(3,0) Microbiological, biochemical, and physiological processes involved in the synthesis of amino acids, proteins, and B-vitamins; relation of these processes to utilization of proteins, lipids, and fibrous and nonfibrous feed ingredients; properties and functions of nutrients, nonprotein nitrogen compounds, and growth-promoting substances for dairy cattle, beef cattle, and sheep. *Preq:* NUTR 401 or consent of instructor.

NUTR 820 Nutritional Bioenergetics 2(2,0) Quantitative approach to the losses of dietary energy during digestion and metabolism; factors governing the energetic efficiency of different biological functions in animals and man; regulation of energy balance; body temperature regulation; techniques of calorimetry. *Preq:* BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or consent of instructor.

NUTR 851 Nutrition Seminar I 1(1,0) Current research and developments in nutrition. Topics, selected by the instructor and students, come from student research and nutrition literature.

NUTR 852 Nutrition Seminar II 1(1,0) Continuation of NUTR 851.

NUTR 891 Master's Thesis Research 1-12

NUTR 991 Doctoral Dissertation Research 1-12

PACKAGING SCIENCE

PKGSC 601 Packaging Machinery 3(3,0) Systematic study of types of machinery used to form, fill, seal, and handle various packages, products, and packaging materials. Emphasizes basic mechanical, electrical, pneumatic, and hydraulic components of packaging machinery along with packaging machinery terminology. Discusses methods for machine line optimization and layout. *Preq:* PKGSC 204, PHYS 208, or consent of instructor.

PKGSC 604 Mechanical Properties of Packages and Principles of Protective Packaging 3(3,0) Study of mechanical properties of products and packages and standard methods of determining these properties. Focuses on the functional properties of packages related to shock and vibration isolation and compression. *Preq:* PHYS 207, MTHSC 106, PKGSC 204, or consent of instructor.

PKGSC 616 Application of Polymers in Packaging 4(3,3) Detailed study of polymer science and engineering as applied to packaging science. Includes polymer morphology, rheology, physical properties, processing methods, and polymerization. Emphasizes relationships among processing, structure, and properties. *Preq:* PKGSC 204, 206; CH 201 or 223; PHYS 207; or consent of instructor.

PKGSC 620 Package Design and Development 3(2,3) Study of principles and methods practiced in designing and developing packages and packaging systems and of methods used to coordinate and analyze package development activities including interfacing with product development, manufacturing, marketing, purchasing, and accounting. *Preq:* Second semester Senior standing; PKGSC 320, 368, 401, 404, 416, 430, 440, 464, or consent of instructor.

PKGSC 630 Converting for Flexible Packaging 3(1,6) Study of materials, methods, processes, and equipment used in converting web materials for flexible packaging. Laboratory provides hands-on experience preparing and operating pilot-scale converting equipment. *Preq:* PKGSC 204, 206; or consent of instructor.

PKGSC 640 Packaging for Distribution 3(3,0) Packages are exposed to various shipping methods and numerous hazards during distribution. To ensure adequate product protection, packaging professionals need to understand the fundamental principles of distribution packaging design. Topics include ASTM and ISTA packaging test methods, packaging design guidelines for distribution, terminology, transport modes, distribution hazards, and protective packaging materials. *Preq:* PKGSC 454 or consent of instructor.

PKGSC 654 Product and Package Evaluation Laboratory 1(0,3) Laboratory experiments to determine properties of packaging materials and to evaluate the response of packages and products to shock, vibration, and compression. Students operate standard testing equipment and become familiar with industry-recognized test methods and standards. *Preq:* PKGSC 404 (or concurrent enrollment).

PKGSC 664 Food and Health Care Packaging Systems 4(3,3) Characteristics, engineering properties, and applications of various materials and systems used in the packaging of foods, pharmaceuticals, and medical devices. Packaging systems for specific food and medical applications are considered. Laboratory and field exercises on food and medical packaging operations and packaging materials are included. Emphasis is on evaluation methods. *Preq:* PKGSC 201, 204, 206, or consent of instructor.

PKGSC 802 International Packaging 3(3,0) International packaging, including material, practices, machinery, marketing, and regulatory compliance principles. *Preq:* Consent of instructor.

PKGSC 804 Flexible Packaging 3(2,3) In-depth study of flexible, plastic-containing primary packages and the methods and materials used to manufacture them. Six representative packages are selected for discussion using a case-study approach. Guest lecturers and plant visits illustrate and amplify the primary instructional materials. *Preq:* PKGSC 416 and 471 or consent of instructor.

PKGSC 806 Semi-Rigid Packaging 3(2,3) Semi-rigid and rigid plastic-containing primary packages and containers and the methods and materials used to manufacture them. Six representative packages are selected for discussion using a case-study approach. Guest lectures and plant visits are used to amplify and illustrate the primary instructional materials. *Preq:* PKGSC 416 and 471 or consent of instructor.

PKGSC 808 Biopolymers in Packaging 3(3,0) In-depth study of the chemical characteristics of biological-based polymers and how these materials can be used in packaging. Students review literature, organize, and present material. *Preq:* Consent of instructor.

PKGSC 821 Selected Problems 1-4(0,1-12) Independent research investigations in packaging science related to packaging materials, machinery, design, and applications in areas not covered in other courses. May be repeated for credit. *Preq:* Consent of instructor.

PKGSC 822 Selected Topics 1-4(1-4,0) Selected topics in packaging science not covered in detail or contained in other courses. May be repeated for credit. *Preq:* Consent of instructor.

PKGSC 851 Packaging Science Seminar 1(1,0) Current research and related developments in packaging science reviewed by faculty, students, and invited lecturers. May be repeated for a maximum of four credits. *Preq:* Consent of instructor.

PKGSC 891 Master's Thesis Research 1-9 Research on a master's thesis topic.

PAN AFRICAN STUDIES

P A S 698 Seminar on Pan African Studies 3(3,0) Research/writing seminar on the African American experience. Selected topics and themes from 1900 to present. *Preq:* HIST 311, 312, 339, or P A S 301.

PARKS, RECREATION, AND TOURISM MANAGEMENT

PRTM 612 Therapeutic Recreation and Mental Health 3(3,0) Therapeutic recreation services in mental health clinics, institutions, and outdoor settings. Review of disorders and current modes of treatment as they relate to therapeutic recreation. *Preq:* PRTM 311, 2.0 cumulative grade-point ratio, consent of instructor.

PRTM 621 Recreation Financial Resources Management 3(3,0) Analysis of recreation financial resources management. Deals with revenue sources and their allocation. *Preq:* PRTM 321, Senior standing in Parks, Recreation, and Tourism Management, 2.0 cumulative grade-point ratio.

PRTM (GEOG) 630 World Geography of Parks and Equivalent Reserves 3(3,0) Major international patterns in the provision and use of urban and rural parks and recreation are examined. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 631 Methods of Environmental Interpretation 3(2,3) Practice and instruction in the use of equipment and methods available to the interpreter in public contact work. Coaching in presentation and evaluation of live programs and in design, execution, and evaluation of mediated programs is the major emphasis. Programs are delivered to public audiences in the Clemson area. *Preq:* PRTM 330; Senior standing in Parks, Recreation, and Tourism Management; 2.0 cumulative grade-point ratio; consent of instructor.

PRTM 641 Commercial Recreation 3(3,0) Components of offering leisure services and products to the public by individuals, partnerships, and corporations for the purpose of making a profit. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 643 Resorts in National and International Tourism 3(3,0) A variety of resort types are studied with respect to their development, organization, visitor characteristics, and environmental consequences. A case-study approach is used. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 644 Tour Planning and Operations 3(3,0) Provides the opportunity to understand the psychology of touring with emphasis on packaged and group tours and how tours of different types and scale are planned, organized, marketed, and operated. *Preq:* PRTM 342, 2.0 cumulative grade-point ratio, consent of instructor.

PRTM 645 Conference/Convention Planning and Management 3(3,0) Provides the opportunity to understand the problems of and solutions to conference and convention planning and management from both the sponsoring organization's and facility manager's perspectives. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 646 Community Tourism Development 3(3,0) Provides a community-based perspective of the organizational, planning, development, and operational needs for a successful tourism economy at the local level. *Preq:* PRTM 342, 2.0 cumulative grade-point ratio, consent of instructor.

PRTM 647 Perspectives on International Travel 3(3,0) Using the United States as a destination, international travel patterns and major attractions are presented. Factors that restrain foreign travel to the United States are analyzed. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 652 Campus Recreation 3(3,0) Study of the basic components required for administration of successful college union and intramural-recreation sport programs. *Preq:* 2.0 cumulative grade-point ratio.

PRTM 801 Philosophical Foundations of Recreation and Park Administration 3(3,0) Current theories and philosophies in recreation as they are influenced by and have influence on leisure and the changing environment in America. Students develop their own professional philosophies of recreation and leisure.

PRTM 802 Group Processes in Leisure Services 3(3,0) Improvement in human relations skills; knowledge of interpersonal needs and problems of individuals and groups. Students gain understanding of how others affect them and how they affect others and become more effective professional recreators, park administrators, supervisors, interpreters, and educators.

PRTM 803 Seminar in Recreation and Park Administration 3(3,0) Case problems relating to administration of a park, recreation, or tourism agency.

PRTM 804 Independent Study 1-3(1-3,0) Topics in recreation, leisure, and tourism not covered in other courses. Written report of findings is required. May be repeated for a maximum of three credits. *Preq:* Consent of supervising faculty prior to registration.

PRTM 805 Internship 1-3 Field placement in an approved agency under qualified supervision. To be taken Pass/Fail only. *Preq:* PRTM major or consent of instructor.

PRTM 806 Special Problems 1-3(1-3,0) Directed, individual comprehensive investigation of a special problem to use knowledge gained in formal courses, provide experience and training in research, and prepare for professional goals. Report of findings is required. May be repeated with a maximum of three credits applied toward graduation requirements. To be taken Pass/Fail only.

PRTM 807 Recreation Behavior in Natural Environments 3(3,0) Social, psychological, and environmental influences on human behavior; identification of theoretical perspectives to explain behavior and to resolve problems in recreation resource management.

PRTM 808 Behavioral Aspects of Parks, Recreation, and Tourism Management 3(3,0) Behavioral aspects of recreation, focusing on the social and psychological dimensions of the recreation experience in a variety of environments and activities.

PRTM 811 Research Methods in Parks, Recreation, and Tourism Management 3(3,0) Principles, methods, and strategies for planning, designing, evaluating, and applying studies of recreation. *Preq:* Graduate-level statistics course or consent of instructor.

PRTM 812 Leisure Services for the Elderly 3(3,0) The elderly and the role of leisure services in later life; needs of community-based and institutionalized elderly; service delivery systems to meet these needs.

PRTM (FOR) 816 Remote Sensing and GIS in Natural Resources 3(2,3) See FOR 816.

PRTM 820 Recreation Resource Policy Issues and Processes 3(3,0) Outdoor recreation policy-formation structures and processes are surveyed through case studies involving past and current public policy issues.

PRTM 840 Tourism Planning 3(3,0) Tourism planning procedures and techniques; planning process and associated concerns such as market, facility, infrastructure, environment, culture, and economics.

PRTM 843 Tourism Analysis 3(3,0) Selected theories, methods, techniques, practices, and principles that govern tourism behavior. *Preq:* Graduate standing or one graduate-level statistics course or consent of instructor.

PRTM (C R P) 844 Outdoor Recreation Resource Management and Planning 3(3,0) See C R P 844.

PRTM 881 Therapeutic Recreation Theories and Concepts 3(3,0) Provides students with the opportunity to analyze critically the philosophical positions influencing service delivery and the theories underlying therapeutic recreation practice models and service delivery. *Preq:* PRTM 880 or undergraduate degree in Parks, Recreation, and Tourism Management.

PRTM 891 Master's Thesis Research 1-12

PRTM 900 Selected Topics 1-3(1-3,0) In-depth, timely study of trends or problems in parks, recreation, and tourism not covered in other courses. May be repeated for a maximum of six credits.

PRTM 908 Advanced Topics 1-3(1-3,0) Topics not covered in other PRTM courses and not directly related to a thesis or dissertation topic. Formal paper is required. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

PRTM 910 Research Seminar 1(1,0) Current research developments in PRTM and presentation of research projects. May be taken for credit for two semesters. To be taken Pass/Fail only.

PRTM 911 Professional Issues in Parks, Recreation, and Tourism Management 1(1,0) Multidisciplinary perspectives to examine concepts and methods related to professional development of parks, recreation, and tourism management graduate students. *Preq:* Admission to PRTM graduate program or consent of instructor.

PRTM 991 Doctoral Dissertation Research 1-12

PHILOSOPHY

PHIL 601 Studies in the History of Philosophy 3(3,0) In-depth study of a selected philosopher, philosophical school, or movement. Topics vary. With departmental consent, may be repeated once for credit. Current topics and course descriptions are available in the department's course offering brochure. *Preq:* Consent of instructor.

PHIL 602 Topics in Philosophy 3(3,0) Thorough examination of a particular philosophical topic, issue, or problem. Topics vary. May be repeated once for credit with departmental consent. Current topics and course descriptions are available in the department's course offering brochure. *Preq:* Consent of instructor.

PHIL 606 Continental Philosophy for Architects 3(3,0) Examines contemporary Continental philosophy over the course of the 20th century, with the goal of offering the proper theoretical background to Architecture students who use such theory in their studies and design work.

PHIL 625 Philosophy of Psychology 3(3,0) Detailed examination of psychology as an autonomous science. Issues include explanation in psychology and cognitive neuroscience, psychology naturalized as a "special science" comparable to biology and geology, evolutionary psychology, philosophy and psychopathology, and moral issues in psychology. *Preq:* Nine hours of psychology or consent of instructor.

PHIL (A A H) 633 Issues in Contemporary Art and Philosophy 3(3,0) Examines the intersections between recent developments in art and those in philosophy and critical theory. Course content varies, for example, Postmodernism in Art and Philosophy, Themes of Resistance in Contemporary Culture.

PHIL 685 Topics in Philosophy of Biology 3(3,0) Detailed analysis of a selected topic in philosophy of biology/theoretical biology. Topics may include the levels of selection debate, sociobiology, genetic explanation and genetic causation, the species question, and the history and sociology of biology. *Preq:* Eight hours of biology or consent of instructor.

PHIL 699 Independent Study 1-3(1-3,0) Course of study designed by the student in consultation with a faculty member who agrees to provide guidance, discussion, and evaluation of the project. Student must confer with the faculty member prior to registration. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

PHIL 845 Aesthetics 3(3,0) Nature and value of aesthetic experiences and objects. Attention is directed to the roles of and relationships among objects, makers, and audiences; interpretation, criticism, and aesthetic response; the contexts and languages of art; the nature of aesthetic value; aesthetics in application; issues in public policy.

PHYSICS

PHYS 617 Introduction to Biophysics I 3(3,0) Introduction to the application of physics to biological problems. Topics include elementary chemical and biological principles, physics of biological molecules, and fundamentals of radiation biophysics. *Preq:* MTHSC 206, PHYS 221, or consent of instructor.

PHYS 620 Atmospheric Physics 3(3,0) Study of physical processes governing atmospheric phenomena. Topics include thermodynamics of dry and moist air, solar and terrestrial radiative processes, convection and cloud physics, precipitation processes, hydrodynamic equations of motion and large-scale motion of the atmosphere, numerical weather prediction, atmospheric electricity. *Preq:* MTHSC 108, PHYS 208 or 221.

PHYS 621 Mechanics I 3(3,0) Statics, motions of particles and rigid bodies, vibratory motion, gravitation, properties of matter, flow of fluids. *Preq:* PHYS 221.

PHYS 622 Mechanics II 3(3,0) Dynamics of particles and rigid bodies, Lagrangian and Hamiltonian formulations, vibrations of strings, wave propagation. *Preq:* PHYS 321 or consent of instructor.

PHYS 632 Optics 3(3,0) Covers a selection of topics, depending on the interest of the student. Topics may include the formation of images by lenses and mirrors, design of optical instruments, electromagnetic wave propagation, interference, diffraction, optical activity, lasers, and holography. *Preq:* PHYS 221.

PHYS 641 Electromagnetics I 3(3,0) Study of the foundations of electromagnetic theory. Topics include electric fields, electric potential, dielectrics, electric circuits, solution of electrostatic boundary-value problems, magnetic fields, and magnetostatics. *Preq:* MTHSC 208 and PHYS 221, or consent of instructor.

PHYS 642 Electromagnetics II 3(3,0) Continuation of PHYS 441. Study of foundations of electromagnetic theory. Topics include magnetic properties of matter, microscopic theory of magnetization, electromagnetic induction, magnetic energy, AC circuits, Maxwell's equations, and propagation of electromagnetic waves. Other topics may include waves in bounded media, antennas, electrodynamics, special theory of relativity, and plasma physics. *Preq:* PHYS 441 or consent of instructor.

PHYS 646 Solid State Physics II 3(3,0) Continuation of PHYS 645, including selected topics in solid-state physics such as optical properties, superconductivity, noncrystalline solids, dielectrics, ferroelectrics, and nanomaterials. Plasmons, polarons, and excitons are discussed. Brief introduction into methods of solid-state synthesis and characterization tools is presented. *Preq:* PHYS 445 or consent of instructor.

PHYS 652 Nuclear and Particle Physics 3(3,0) Study of our present knowledge concerning subatomic matter. Experimental results are stressed. Topics include particle spectra, detection techniques, Regge pole analysis, quark models, proton structure, nuclear structure, scattering and reactions.

PHYS 655 Quantum Physics I 3(3,0) Discussion of solution of the Schrodinger equation for free particles, the hydrogen atom, and the harmonic oscillator. *Preq:* PHYS 322 and 441 or consent of instructor.

PHYS 656 Quantum Physics II 3(3,0) Continuation of PHYS 455. Application of principles of quantum mechanics as developed in PHYS 455 to atomic, molecular, solid state, and nuclear systems. *Preq:* PHYS 455.

PHYS 665 Thermodynamics and Statistical Mechanics 3(3,0) Study of temperature development of the laws of thermodynamics and their application to thermodynamic systems. Introduction to low temperature physics is given. *Preq:* Six hours of physics beyond PHYS 222 or consent of instructor.

PHYS 811 Methods of Theoretical Physics I 3(3,0) Analytical methods and techniques used in theoretical physics: vector and tensor analysis as applied to physical problems, use of matrices and groups in classical and quantum mechanics, complex variables, and partial differential equations of physics.

PHYS 812 Methods of Theoretical Physics II 3(3,0) Continuation of PHYS 811. Use of integral transforms, integral equations, special functions, calculus of variations, and numerical approximations in solutions of physical problems.

PHYS (M E) 815 Statistical Thermodynamics I 3(3,0) Fundamental principles of kinetic theory and quantum statistical mechanics; Boltzmann statistics, Fermi-Dirac statistics, and Bose-Einstein statistics. *Preq:* A course in thermodynamics or consent of instructor

PHYS 816 Statistical Thermodynamics II 3(3,0) Generalized ensemble theory and fluctuations; applications to solids, liquids, gases, and blackbody radiation. *Preq:* PHYS (M E) 815.

PHYS 821 Classical Mechanics I 3(3,0) Dynamics of particles; variational principles and Lagrange's equations; two-body central force problems; dynamics of rigid bodies; matrix formulations freely used.

PHYS 822 Classical Mechanics II 3(3,0) Special relativity in classical mechanics; Hamilton's equations; canonical transformations; Hamilton-Jacobi theory; small oscillations.

PHYS 841 Electrodynamics I 3(3,0) Field theory of electromagnetism; Maxwell's equations and their application to study of electromagnetic wave production and propagation; wave optics and theories of interference and diffraction.

PHYS 842 Electrodynamics II 3(3,0) Production and propagation of electromagnetic waves beginning with use of Maxwell's equations; wave guides; diffraction phenomenon; boundary effects; theory of electrons and microscopic phenomena.

PHYS 845 Solid State Physics I 3(3,0) Physical properties of crystalline solids; crystalline state determination by diffraction methods; theories of specific heat; properties of metallic lattices and alloys; lattice energy and ferroelectrics.

PHYS 846 Solid State Physics II 3(3,0) Continuation of PHYS 845. Electronic properties of solids, band theory of solids, physics of semiconductors, theories of magnetism, and magnetic resonance phenomena.

PHYS 875 Selected Topics 1-3(1-3,0) Students and interested faculty study areas of physics currently being extensively investigated. May be repeated for credit, but only if different topics are covered.

PHYS 890 Directed Activities in Applied Physics 1-6 Training and work on practical problems are supervised by department faculty or by appropriate adjunct professor. Written description of student's activities must be submitted to course supervisor at completion of activity. Maximum credit limits are six credit hours in a semester and three credit hours in a single summer session. To be taken Pass/Fail only.

PHYS 891 Master's Thesis Research 1-12

PHYS 951 Quantum Mechanics I 3(3,0) Review of wave mechanics, operator algebra and theory of representation, approximate methods for stationary problems, theory of scattering applied to atomic and nuclear problems.

PHYS 952 Quantum Mechanics II 3(3,0) Continuation of PHYS 951. Time-dependent perturbations, radiation, absorption and emission, relativistic quantum mechanics, introduction to quantum electrodynamics.

PHYS 966 Relativity 3(3,0) Special and general theory of relativity including tensor calculus, Lorentz transformation and three experimental tests of general theory: planetary motion and advance of perihelion of Mercury, bending of light rays in gravitational fields, and gravitational shift of spectral lines.

PHYS 991 Doctoral Dissertation Research 1-12

PLANT AND ENVIRONMENTAL SCIENCES

PES 825 Seminar 1(1,0) Special topics and original research in plant and environmental sciences. To be taken Pass/Fail only.

PES 826 Scientific Writing 1(1,0) Written communication in the plant sciences. To be taken Pass/Fail only.

PES (CSENV) 850 Agricultural Biotechnology 2(2,0) See CSENV 850.

PES 891 Master's Thesis Research 1-18

PES 991 Doctoral Dissertation Research 1-18

PLANT PATHOLOGY

PL PA (ENT) 606 Diseases and Insects of Turfgrasses 2(2,0) Host-parasite relationships, symptomatology, diagnosis, economics, and control of infectious diseases of turfgrasses; and life histories, diagnosis, and control of important insect pests of turfgrasses. *Preq:* ENT 301, PL PA 310, or equivalent; or consent of instructor.

PL PA (ENT) 608 Diseases and Insects of Turfgrasses Laboratory 1(0,3) Laboratory to complement PL PA (ENT) 406 to learn symptomatology, diagnosis and control of infectious diseases of turfgrasses, and diagnosis of damage caused by important insect pests of turfgrasses. *Preq:* PL PA (ENT) 406.

PL PA 611 Plant Disease Diagnosis I 2(1,2) Methods and procedures used in the diagnosis of plant diseases, especially late spring and early summer diseases. Basic techniques of pure culture and identification of plant pathogens and Koch's postulates are taught. Diagnosis of a wide variety of diseases of cultivated and wild plants is carried out. Offered summer session only. *Preq:* PL PA 310 or equivalent.

PL PA (BIOSC) 625 Introductory Mycology 3(3,0) See BIOSC (PL PA) 625.

PL PA (BIOSC) 626 Mycology Practicum 2(1,3) See BIOSC (PL PA) 626.

PL PA 659 Plant Nematology 3(2,3) Introduction to nematodes emphasizing plant parasitic nematodes. Introduces morphology of nematodes as it relates to their taxonomic position and ability to cause diseases. Includes diagnosis and control of nematode diseases, along with use of nematodes in studies of molecular interaction and genetics involvement in developing resistance. *Preq:* PL PA 310 or consent of instructor.

PL PA 670 Molecular Plant Pathogen Interactions 3(3,0) Study of the interactions of plants and pathogens at the molecular level. Investigates the molecular and genetic components of plant disease and how these can be used for improvement and understanding of how diseases occur and how these can be used for possible disease management. *Preq:* PL PA 310.

PL PA 802 Selected Topics 1-3(1-3,0-6) Current advances in phytopathology and physiology, diseases of specific crops and specialized laboratory protocol. May be repeated for credit. *Preq:* Consent of instructor.

PL PA 804 Plant-Microbe Interactions 3(3,0) Physiology, biochemistry, and genetics of plant-microbe interactions; molecular mechanisms involved in plant-microbe communication, plant colonization, and penetration; development of the microbe within the plant; induction of plant defense responses. Offered fall semester of even-numbered years only. *Preq:* BIOSC 401 and 402 or PL PA 310 or consent of instructor.

PL PA 805 Special Problems in Plant Pathology 1-12 Research not related to a thesis. *Preq:* PL PA 411 or equivalent and consent of instructor.

PL PA 807 Seminar 1(1,0) Areas of plant pathology and plant physiology not covered by formal courses. Relevant literature is reviewed. Material is organized and presented by students. To be taken Pass/Fail only.

PL PA 809 Analytical Techniques in Plant Science 3(2,3) Theory of and practice in current techniques of separation science; hands-on experience with extraction, isolation, and characterization of chemical compounds associated with plants and microorganisms using techniques such as thin layer chromatography, gas chromatography, mass spectroscopy, high pressure liquid chromatography, and electrophoresis. *Preq:* Organic chemistry, general biochemistry, or consent of instructor.

PL PA 810 Fungal and Bacterial Plant Pathogens 4(3,3) Biology and molecular biology of plant pathogenic fungi and bacteria; principles of taxonomy, evolution, morphological structures, life cycles, population biology, ecology, control, and genetic manipulation of representative fungal and bacterial pathogens encountered by plant pathologists. *Preq:* PL PA 310, MICRO 305 or equivalent.

PL PA 811 Plant Viruses and Plant Parasitic Nematodes 4(3,3) Biology and molecular biology of plant viruses and plant-parasitic nematodes; taxonomy, evolution, life cycles, population biology, ecology, control, and genetic manipulation of representative viruses and plant-parasitic nematodes encountered by plant pathologists. *Preq:* PL PA 310 or equivalent.

PL PA 813 Fungal Ecology and Pathology 3(2,3) Study of the biology and activities of fungi with emphasis on their interactions with other organisms and roles in natural and managed ecosystems. Includes survey of different types of symbiotic relationships with particular attention to plant pathogens and mycorrhizae and their management. *Preq:* BIOSC 425, 426.

POLICY STUDIES

PO ST 810 Political Economy 3(3,0) Exploration of how public policy can be analyzed within a common framework that considers the objectives and constraints imposed on individuals in political and economic situations, decision rules consistent with these objectives and constraints, and the likely outcomes of various policy objectives. *Preq:* ECON (AP EC) 820 or consent of instructor.

PO ST 822 Policy Analysis and Political Choice 3(3,0) Opportunities and constraints in political systems; political feasibility and policy strategy assessment. Topics include role of power, ideas, organizational interaction, cognitive processes, interest groups, policy analysis, media, and random opportunity in determining policy outcomes. *Preq:* Admission to Policy Studies program or consent of instructor.

PO ST 842 Ethics and Public Policy 3(3,0) Exploration of the ethical dimensions of policy by examining moral and ethical issues raised by problem solving and decision making. Evaluation procedures integrating ethical dimensions into policy assessment. Topics include model codes of ethics for public officials and comparable standards for privately employed policy professionals. *Preq:* Admission to certificate or PhD program in Policy Studies or consent of instructor.

PO ST 843 Organization Theory and Public Management 3(3,0) Theoretical and analytical foundations for understanding bureaucracies and leadership roles in public management; clarification of the distinctly "public" dimensions and challenges of management. Interdisciplinary in nature, course draws on business and public administration, social psychology, economics, political science, and sociology. *Preq:* Admission to certificate or PhD program in Policy Studies or consent of instructor.

PO ST 851 Rural Sustainable Development: Evolution of Public Policy 3(3,0) Formulation of current national and local public policies that impact rural community development; the constraints and opportunities they provide; interaction among government institutions, decision makers, and interest groups; associated influence on rural sustainability. *Preq:* Admission to certificate or PhD program in Policy Studies or consent of instructor.

PO ST 861 Space Policy 3(3,0) Space science technology, civilian and military government programs, and private-sector activities. Case studies of long-term space policy issues impacting remote sensing, communications, and manned space stations. Examination of origins of programs and evolution of associated policy issues from a national and international perspective. *Preq:* Admission to certificate or PhD program in Policy Studies or consent of instructor.

PO ST (C R P) 870 Seminar in Sustainable Development 3(3,0) Concept of sustainable development traced from its historical roots through the popularization of the term in the international development literature; scientific base and the application of sustainability through economic sectors and building practice. Students conduct individual/group research projects.

PO ST 890 Directed Study in Public Policy 3(3,0) Students pursue readings and research in individual public policy topics under the direction of a Policy Studies faculty member. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

PO ST 893 Internship in Policy Analysis 3(3,0) Twelve-week supervised internship with an approved public or private entity focusing on policy analysis. Monthly reports by student and agency are required. To be taken Pass/Fail only. *Preq:* Two semesters of coursework in Policy Studies program.

PO ST 898 Policy Analysis Workshop 3(0,6) Provides experience with contemporary policy issues. Students work in small groups with clients compiling information, developing policy options, and conducting analysis to address a policy issue. White paper is prepared analyzing policy options and making recommendations to policy makers. Typically taken in fourth semester. *Preq:* Three semesters of coursework in Policy Studies program.

PO ST 899 Selected Topics in Policy Studies 3(3,0) Intensive investigation of selected current and emerging public policy issues emphasizing current literature and results of current research. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

PO ST 904 Policy Analysis Seminar I 2(2,0) Seminar module focusing on research methodology with readings and discussion. *Preq:* Three semesters of coursework in Policy Studies program.

PO ST 905 Policy Analysis Seminar II 1(1,0) Seminar involving student research with articles prepared for a professional audience and presented as part of the seminar. *Preq:* PO ST 904, three semesters of coursework in Policy Studies program.

PO ST 991 Doctoral Dissertation Research 1-18

POLITICAL SCIENCE

PO SC 609 Directed Study in American Politics 1-3(1-3,0) Supervised reading and/or research in selected areas of American government. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

PO SC 616 Interest Groups and Social Movements 3(3,0) Empirical and normative examination of the origins, roles, and influence of interest groups and social movements in the United States and of the relationships among interest groups, social movements, and democratic theory. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 621 Public Policy 3(3,0) Introduction to the major approaches to public policy making in American government. Topics include theories and models of policy making, the identification of policy problems, agenda setting, the formulation and adoption of policy, implementation, and program evaluation. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 623 Urban Politics 3(3,0) Examines the nature and scope of politics in urban communities and offers an analysis of urban governance, especially in the interaction of public authority and private institutions in metropolitan areas. Emphasis is on the structure, processes, and problems challenging governments in urban America. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 624 Federalism and Intergovernmental Relations 3(3,0) Introduction to historical, theoretical, legal, and fiscal aspects of constitutionally divided government. Federal, state, and local division of responsibility for public services is emphasized along with the emerging devolution of those responsibilities from the federal government to states and localities. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 627 Public Management 3(3,0) Examination of emerging management problems and issues facing federal, state, and local government and the application of management principles, practices, and techniques of public administration. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 628 National Security Policy 3(3,0) National security threats and policy decision making. Issues covered include weapons of mass destruction, terrorism, organized crime, narcotics, arms control, intelligence, and homeland security. Students deliberate and assess threat priorities and crisis management. *Preq:* PO SC 102 or 104, Junior standing, or consent of instructor.

PO SC 629 Global Issues 3(3,0) Analysis, assessment, and management of the principal threats facing global security today. Topics include rogue nations, regional superpowers, alliances, organized crime, illegal weapons proliferation, and corruption. Emphasis is on the strategies available to the international community for dealing with these threats. *Preq:* PO SC 102 or 104, Junior standing, or consent of instructor.

PO SC 637 American Constitutional Law: Rights and Liberties 3(3,0) Examination and analysis of Supreme Court decisions and other legal materials in the areas of civil rights and civil liberties, with an emphasis on freedom of speech, freedom of religion, equal protection of the laws, and privacy rights. *Preq:* Junior standing or consent of instructor.

PO SC 638 American Constitutional Law: Structures of Government 3(3,0) Examination and analysis of Supreme Court decisions and other legal materials in the areas of national power, federalism, the separation of powers, and the role of the judiciary. *Preq:* Junior standing or consent of instructor.

PO SC 642 Political Parties and Elections 3(3,0) Study of the distinctive features of the American two-party system with emphasis on presidential elections. Parties are examined as formal organizations, coalitions of voters and interest groups, coordinators of nomination and election processes, and managers of policy-making institutions. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 654 Southern Politics 3(3,0) Examination of the unique political environment of the American South, with emphasis on the events and social forces which have shaped politics in the region since World War II. Course material is approached from a variety of perspectives, including history, literature, social themes, and political culture. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 657 Political Terrorism 3(3,0) Examination and analysis of the international phenomenon of terrorism in terms of origins, operations, philosophy, and objectives. *Preq:* PO SC 102 or 104, Junior standing, or consent of instructor.

PO SC 658 Political Leadership 3(3,0) Comparative examination of political leaders focusing particularly on types, methods, and consequences of leadership and on the relationship between leaders and followers. *Preq:* PO SC 101, Junior standing, or consent of instructor.

PO SC 661 American Diplomacy and Politics 3(3,0) Analyzes the process of making and implementing strategies to protect and promote American national interests. Focuses on the role of government agencies and executive-legislative relations, as well as the participation and influence of interest groups and the media. Includes a five-day seminar in Washington, DC. *Preq:* PO SC 363 or consent of instructor.

PO SC 680 Gender and Politics 3(3,0) Examination of the role of gender in politics in the United States and in other countries. Particular emphasis on the role of women in electoral politics, the impact of nationalist violence, and development policies on women's lives, and on women's rights as human rights. *Preq:* PO SC 101, 102, or 104, Junior standing, or consent of instructor.

PO SC (LANG) 685 Global Affairs and Governments 3(3,0) Designed for teachers and education students who wish to learn how to incorporate global affairs more fully into high school curricula. Overview of major topics involving foreign policies and world politics is provided.

PO SC 689 Selected Topics 1-3(1-3,0) Intensive examination of a selected area of political science. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of instructor.

PO SC 841 Public Data Analysis 3(3,0) Various aspects of database management, storage, and retrieval; data description; univariate, bivariate, and multivariate analysis in policy studies and decision-making theory. *Preq:* EX ST 301, MTHSC 301, or equivalent.

PO SC 860 American Government 3(3,0) Literature of the American political system, its institutions and processes.

PO SC 877 Public Policy Evaluation Seminar 3(3,0) Conceptual and analytic issues in policy and program evaluation including problem definition, goal setting, and criteria formulation; design of evaluation research; indicator design; treatment of uncertainty; and special problems raised by constraints of the political context.

PO SC 878 Selected Topics in Public Administration 3(3,0) In-depth study of an applied problem in public administration as seen through the practitioner's eyes; the methods used to address these problems.

POLYMER AND FIBER CHEMISTRY

PFC 615 Introduction to Polymer Science and Engineering 3(3,0) Chemistry of monomers and polymers and the chemical and physical properties of polymers are discussed emphasizing fiber forming, synthetic polymers. Includes molecular characterization, structure, morphology, and mechanical properties as they relate to the design of polymer systems for end uses in textiles, geotextiles, plastics, and fiber-reinforced composite materials. *Preq:* CH 201; 224 or 330; PFC 304; or consent of instructor.

PFC 616 Chemical Preparation of Textiles 3(2,3) Chemicals used in the preparation of fabric for dyeing and finishing. Oxidizing and reducing agents and their control and effect on various fibers. Colloidal and surface active properties of various compounds and the fundamental factors influencing these properties.

PFC 657 Dyeing and Finishing I 3(3,0) Physical, chemical, and mechanical principles behind the application of colors and finishes to textiles. Requires an appreciation of fiber chemistry and morphology, dye and finish structures, and reactivity and mechanical principles behind the equipment used to effect transfer of these chemicals onto the textile substrate.

PFC 658 Dyeing and Finishing II 3(3,0) Kinetics and equilibria of dyeing processes. The use of conductivity, diffusion, and other methods for measuring absorption of isotherms and dyeing rates and the general thermodynamic relationships applicable to dyeing operations. Fiber properties such as zeta potential, dye site, and relative amorphous area available are included.

PFC 661 Surface Phenomena in Fiber Science 3(3,0) Introduction to surface phenomena focusing on fiber science. Fundamentals of interfacial phenomena embrace thermodynamics of surfaces, physics of adhesion, wetting, and finishing emphasizing specific features associated with interactions of liquids and chemicals with fibers and fibrous materials. *Preq:* Junior standing in engineering or science.

PFC 811 Polymer Science I 3(3,0) Fundamentals of polymer chemistry. Chemistry and synthesis of monomers and polymers in relation to thermodynamics, kinetics, and mechanisms of polymerization reactions emphasizing fiber-forming polymers, plastics, and composite matrix materials. Offered fall semester only.

PFC 812 Polymer Science II 3(3,0) Chemical structure and properties of polymers. Polymer solution properties, the viscoelastic state, and the crystalline morphology of polymeric materials. Current theories for describing polymer thermal transitions, molecular weight, molecular weight distributions, and transport phenomena in polymeric systems, as well as interfacial phenomena. Offered spring semester only.

PFC 830 Multicomponent Polymeric Materials 3(3,0) Principles of advanced multicomponent polymeric materials and systems based on the following topics: different polymer-polymer and polymer-nonpolymer combinations; multicomponent materials synthesis, fabrication, properties, and applications; modification and instrumental characterization of polymer surfaces and interfaces; functional coatings, nanocomposites, adhesives, nanodevices, polymer blends and composites, interpenetrating polymeric networks, and block-copolymers. *Preq:* Introductory polymer course or consent of instructor.

PFC 840 Analytical Methods in Textile and Polymer Science 4(3,3) Use of chemical and physical instrumental methods to characterize polymeric materials in textile and polymer science; basic principles and unique problems encountered when techniques such as IR, NMR, GC, LC, MS, GC/MS and thermal analysis, microscopy, and tensile testing are applied to polymeric materials. Offered spring semester only. *Preq:* Consent of instructor.

PFC 891 Master's Thesis Research 1-12

PSYCHOLOGY

PSYCH 626 Advanced Physiological Psychology 3(3,0) Advanced studies in the biological basis of behavior with emphasis on functional neuroanatomy and endocrinology. Topics may vary. May not be repeated for credit. *Preq:* PSYCH 324 or consent of instructor.

PSYCH 662 Psychology and Culture 3(3,0) Seminar examining the cultural context in which psychological theories and research are generated and psychological perspectives on human diversity. Topics include the philosophical positions influencing psychological theory and research; methodological issues in the study of diversity; historical and contemporary perspectives; and cross-cultural psychological research in selected content areas. *Preq:* PSYCH 310 or consent of instructor.

PSYCH 680 Health Psychology 3(3,0) Study of

- the role of health-related behaviors in the prevention, development, and/or exacerbation of health problems. Emphasis is on the biopsychosocial model and its application in the assessment, treatment, and prevention of health problems. *Prq:* PSYCH 201 with a C or better and one 300-level psychology course or consent of instructor.
- PSYCH 683 Abnormal Psychology 3(3,0)** Introduction to the diagnosis and treatment of mental illness. Uses current diagnostic standards for mental disorders as a framework for understanding the symptoms, causes, and treatments of the most commonly observed maladaptive behaviors. *Prq:* PSYCH 201 with a C or better and one 300-level psychology course or consent of instructor.
- PSYCH 689 Selected Topics 3(3,0)** Seminar in current topics in psychology. Topics vary from semester to semester and are announced prior to each semester's registration. May be repeated once for credit, but only if different topics are covered. *Prq:* PSYCH 201 with a C or better and one 300-level psychology course or consent of instructor.
- PSYCH 810 Research Design and Quantitative Methods I 3(3,0)** Overview of applied data analysis in industrial and other work-related settings. Analysis techniques focus on the General Linear Model approach to ANOVA and regression. *Prq:* Six credits of statistics, research methods or equivalent.
- PSYCH 811 Research Design and Quantitative Methods II 3(3,0)** Research methodologies; experimental, quasi-experimental, and nonexperimental designs emphasizing applied psychological research; scientific method; basic versus applied research; technical writing; grant writing and ethics. *Prq:* PSYCH 810.
- PSYCH 813 Research Design and Quantitative Methods III 3(3,0)** Advanced course in applications of multivariate data analysis in industrial and other work-related settings. Topics include the major advanced and multivariate data analytic tools needed for research in applied psychology. *Prq:* PSYCH 810 or consent of instructor.
- PSYCH 815 Advanced Studies in Systems and Theories 3(3,0)** Foundations of contemporary psychology, origins of major theories, conceptions of scientific knowledge implicit in them, and reasons for accepting or rejecting them. *Prq:* PSYCH 415 or consent of instructor.
- PSYCH 822 Human Perception and Performance 3(3,0)** Basic research on human perception as applied to task performance; vision and audition in adults; basic knowledge of human sensory and perceptual characteristics as applied to such tasks as machine operation, task performance, etc.
- PSYCH 823 Perception, Cognition, and Technology 3(3,0)** Fundamentals of sensory and perceptual processes focusing on human vision and audition. Emphasis is on perceptual aspects of applications and communication in electronic and traditional media. Topics include perception of speech, time, depth, color, and motion in natural and virtual environments, as well as psychophysics, attention, eye movements, and reading. *Prq:* Enrollment in MFAC degree program or consent of instructor.
- PSYCH 833 Advanced Cognitive Psychology 3(3,0)** Research and theory concerning perception, memory, reasoning, problem solving, knowledge representation, psychology of language, semantics, attention, concept formation, and other high-level mental processes. Applications of these areas are considered.
- PSYCH 835 Advanced Human Factors Psychology 3(3,0)** Foundation from which to study interactions between human beings and systems in order to maximize safety, performance, and user satisfaction. Integration and application of basic research and theory in sensation, perception, cognition, and motor control. *Prq:* Consent of instructor.
- PSYCH 837 Ergonomics for Applied Psychology 3(3,0)** Perception and action capabilities of humans as they relate to the design of machines and environments; biomechanics, anthropometry, human movement and work, and the perceptual support of action.
- PSYCH 840 Usability Analysis and Crew Assessment 3(3,0)** Hands-on exposure to human factors methods for evaluating the usability of computer interfaces and assessing team performance in fast-paced tasks. May include cognitive task analysis, heuristic evaluation, usability testing, sequential data analysis, cognitive modeling, workload and situation-awareness measurement, measurement of team knowledge, operating simulators. *Prq:* PSYCH 810 or 835 or consent of instructor.
- PSYCH 845 Advanced Studies in Adulthood and Aging 3(3,0)** Human development from young adulthood through late adulthood. Biological, cognitive, personality development, and social development are examined from the perspective of several major theoretical frameworks. *Prq:* PSYCH 345 or consent of instructor.
- PSYCH 852 Advanced Studies in Social Psychology 3(3,0)** Human social behavior from the perspective of the individual as a participant in social relationships; contemporary theories of human social behavior and human behavior in social settings. *Prq:* PSYCH 352 or consent of instructor.
- PSYCH 860 Psychology of Training and Evaluation 3(3,0)** Evaluation issues such as criteria development, organizational assessment, process, and outcome criteria along with instructional methodologies such as fairness in training, special populations, second careers, hard-core unemployment, and ethics of organizational and industrial change. *Prq:* A course in industrial psychology, personnel psychology, or equivalent.
- PSYCH 861 Personnel Psychology 3(3,0)** Theory, techniques, and legal issues involved in the effective matching of individuals' needs, preferences, skills, and abilities with the needs and preferences of organizations. Topics include research methods, prediction issues, tests and other predictors, decision making, and job evaluation. *Prq:* PSYCH 810.
- PSYCH 862 Organizational Psychology 3(3,0)** Investigation of forms of organizational structure and basic theories of organizations. Includes research and theories on human behavior in organizations including motivation, leadership, and job satisfaction. Discusses relationships between theories and research on human behavior and organization development and change. *Prq:* A course in industrial/organizational psychology or equivalent.
- PSYCH 863 Work Motivation and Satisfaction 3(3,0)** Explanations for absenteeism, productivity, job satisfaction, and withdrawal, as well as their interrelations. Methods of measuring attitudes and opinions and general theories of human motivation. *Prq:* A course in industrial/organizational psychology or equivalent.
- PSYCH 864 Performance Appraisal 3(3,0)** Job measurement and the psychological processes involved in performance appraisal. Current methods, theory, and applications in the measurement of job performance. Training in the development and evaluation of performance appraisal systems. *Prq:* PSYCH 364 or consent of instructor.
- PSYCH 866 Attitude Measurement Theory 3(3,0)** Classic and contemporary approaches to attitude theory, measurement, and scaling techniques. Theories of job satisfaction. Measurement of attitudes toward work. *Prq:* PSYCH 471 or consent of instructor.
- PSYCH 867 Legal Issues in Personnel 3(3,0)** Discrimination law and its relevance to the practice of industrial/organizational psychology. Compliance with Title 7, the Age Discrimination in Employment Act, and the Americans with Disabilities Act. *Prq:* PSYCH 861 and 871 or consent of instructor.
- PSYCH 868 Leadership in Organizations 3(3,0)** Theories of leadership and current leadership research. Theoretical approaches include trait, behavioral, contingency, transactional, and transformational approaches. Current leadership issues may include leadership perceptions, gender and leadership, and executive succession. *Prq:* A course in industrial/organizational psychology or equivalent.
- PSYCH 869 Advanced Personnel Selection 3(3,0)** Advanced seminar covering details of personnel selection techniques used in organizations. Techniques covered may include biodata, cognitive and physical ability tests, personality tests, interviews, and assessment centers. *Prq:* PSYCH 861.
- PSYCH 871 Psychological Tests and Measurement 3(3,0)** Advanced survey of psychological test development, evaluation, and utilization in organizational and research settings; professional guidelines for the practice of testing in industrial/organizational psychology and legal guidelines for using tests in industry. *Prq:* Consent of instructor.
- PSYCH 873 Structural Equation Modeling in Applied Psychology 3(3,0)** Fundamentals of the statistical techniques involved in structural equation modeling (SEM) in applied psychology. SEM is a regression-based technique that incorporates elements of path analysis, confirmatory factor analysis, and structural models. *Prq:* PSYCH 810 or consent of instructor.

PSYCH 882 Survey of Occupational Health Psychology 3(3,0) Issues in the newly developing field of occupational health psychology; integration of knowledge bases from human factors, industrial-organizational, health psychology, and related disciplines; biopsychosocial perspective where students develop problem-solving skills and interdisciplinary knowledge. *Preq:* Prior psychology coursework or consent of instructor.

PSYCH 883 Advanced Studies in Abnormal Psychology 3(3,0) Seminar on the etiology and classification of abnormal behavior; empirical and theoretical issues in the understanding of mental disorders; cultural influences on judgment of abnormality; in-depth examination of specific psychological disorders. *Preq:* PSYCH 483 or consent of instructor.

PSYCH 885 Organizational Stress 3(3,0) Considers stressors in the workplace that have the capacity to undermine an individual's well-being and performance. Addresses comprehensive models of organizational stress, methodological challenges in studying workplace stress, factors that reduce the negative impact of stress, and organizational interventions to reduce the negative consequences.

PSYCH 891 Master's Thesis Research 1-3

PSYCH 895 Applied Psychology Internship 3-6(0,3-6) Supervised field experience in industry, business, or government. Site location, on-site supervision, and credit hours must be approved in advance by graduate coordinator.

PSYCH 897 Special Problems in Applied Psychology 1-3 Study of a particular topic under the direction of a faculty member. Specific program is organized by student and faculty member and submitted to graduate coordinator for approval. Project is not used to support MS thesis or dissertation. May be repeated for a maximum of 21 credits.

PSYCH 899 Selected Topics 3(3,0) Selected current and classic topics not covered in other courses. May be repeated for credit.

PSYCH 991 Doctoral Dissertation Research 1-9

PUBLIC ADMINISTRATION

Courses listed in brackets (e.g., P ADM 702 [POLI 502]) are offered by the University of South Carolina.

P ADM 702 [POLI 502] Research Methods for Public Administration 3(3,0) Use of social science research methods for addressing issues in public management and policy; research design; measurement; sampling and polling; various aspects of locating, collecting, and processing data, including survey design and archive searches.

P ADM 821 [POLI 770] Perspectives on Public Administration 3(3,0) Study and practice of public administration in the United States in the 20th century; historical development of the field of public administration; current approaches to the study and practice of public administration.

P ADM 822 [POLI 774] Public Policy Process 3(3,0) Major models of policy making including incrementalism, rationalism, pluralism, and elitism; selected areas of public policy including transportation, poverty, energy, and the environment.

P ADM 827 [POLI 773] Public Personnel Administration 3(3,0) Organization, techniques and theories of personnel management; interpersonal relations in organizations; personnel change and development; changing conditions in the public service; educational specializations, unions, collective bargaining, etc.; ethics for the public service.

P ADM 829 [POLI 775] Public Financial Management 3(3,0) Organization and techniques of governmental financial management; budgetary theories; intergovernmental financial relations.

P ADM 830 Constitutional Law for Public Administration 3(3,0) Principles of American constitutional law; legal issues related to public administration including delegation of power, separation of powers, due process, and civil rights and liberties. May not be taken for credit by students who have taken PO SC 632 or 633 or their equivalents.

P ADM 834 Administrative Law 3(3,0) Legislative, adjudicatory, and general policy-making powers of administrative agencies and regulatory commissions; the scope of judicial review of administrative action. Directed primarily toward the analysis of the political nature of bureaucracy.

P ADM 841 Public Data Analysis 3(3,0) Considers various aspects of database management, storage, and retrieval; data description; univariate, bivariate, and multivariate analysis in policy studies and decision-making theory. *Preq:* EX ST 301, MTHSC 301, or equivalent.

P ADM 860 American Government 3(3,0) Examines literature of the American political system, its institutions, and processes.

P ADM 862 Administrative Leadership 3(3,0) Foundations of leadership in public organizations; personal and organizational values underlying decision processes in the public service.

P ADM 863 [POLI 772] Contemporary Administrative Organizations 3(3,0) Problems, processes, and theories of communication, decision-making, agency planning, and control in administrative agencies.

P ADM 867 State Government Administration 3(3,0) State government problems and policy issues emphasizing the modernization of government institutions and comparative state politics.

P ADM 868 [POLI 768] Local Government Administration 3(3,0) Administration of local government from the perspective of the professional administrator; the growth of the manager form of local government; the role of local government administrators with regard to policy making, management, and the delivery of services.

P ADM 877 Public Policy Evaluation Seminar 3(3,0) Investigates conceptual and analytic issues in policy and program evaluation including problem definition, goal setting, and criteria formulation; design of evaluation research; indicator design; treatment of uncertainty; and special problems raised by constraints of the political context.

P ADM 878 Selected Topics in Public Administration 3(3,0) In-depth study of an applied problem in public administration as seen through the practitioner's eyes; investigates the methods used to address these problems. May be repeated for credit, but only if different topics are covered.

P ADM 879 [POLI 779] Internship in Public Administration 1-3(1-3,0) Internship with a government agency requiring a written report detailing the experience.

P ADM 880 [POLI 753] Capstone Seminar in Public Administration 3(3,0) Term project integrating the material from other courses in the analysis of a contemporary public administration problem. Field work and applied project required. *Preq:* Thirty credit hours toward MPA degree and consent of instructor.

P ADM 891 Master's Thesis Research 1-6

READING

READ 860 Reading Instruction in the Elementary School 3(3,0) Knowledge and skills necessary for teaching reading to varied types of elementary school learners. *Preq:* Consent of instructor.

READ 861 Fundamentals of Basic Reading 3(3,0) Historical progression of the teaching of reading; current theories and reading practices; teaching basic reading skills.

READ 862 Clinical Research in Reading 3(3,0) Reading research and literature; original investigation in such problems as development of reading skills and attitudes, clinical procedures, and techniques is required. *Preq:* READ 861.

READ 863 Organizing and Supervising Reading Programs 3(3,0) Supervisory problems with planning reading programs; analysis of methods and materials of teaching; evaluation of reading programs. *Preq:* One of the following: READ 860, 861, 864, 865, 869.

READ 864 Teaching Secondary School Reading 3(3,0) Methods and materials for secondary reading programs in developmental, corrective, remedial, adapted, content, and recreational areas.

READ 865 Evaluation and Remediation of Reading Problems 3(2,3) Remedial methods and materials for teaching reading; use of diagnostic instruments and interpretation of test results. Students participate in laboratory/field experience and prepare case studies with summary of diagnosis emphasizing remediation procedures. *Preq:* READ 860, 861, or 864.

READ 866 Practicum in Reading 3(2,2) Supervised practicum emphasizing diagnostic and remedial work with readers in public schools. *Preq:* READ 865, consent of instructor.

READ 867 Middle School Reading 3(3,0) Techniques, materials, and theories for teaching reading to middle school students emphasizing correlating reading skills into the content area. *Preq:* Education major or consent of instructor.

READ 868 Using Literature and Technology for Reading Instruction 3(3,3) Provides early childhood, elementary, and middle school teachers with theory and knowledge needed to utilize technological and library resources and make appropriate literature selections for the teaching of reading.

READ 869 Integrated Approach to Reading and Writing Instruction 3(3,0) Understanding of the reading/writing processes for early childhood and elementary teachers; investigation of the whole language approach in the classroom. *Preq:* READ 861 or equivalent.

- READ 870 Early Literacy: Strategic Reading and Writing Instruction 3(3,0)** Use of the theoretical base of the Reading Recovery program to modify instructional practices to include generalizable instructional procedures. *Preq:* READ 860 or equivalent.
- READ 871 Literacy Across the Curriculum 3(3,0)** Use of the theoretical base of the Reading Recovery program to modify instructional practices to include reading and writing activities in all aspects of K–5 curriculum. *Preq:* READ 860 or equivalent and 870.
- READ 872 Guided Reading and Guided Writing 3(3,0)** Use of the techniques of Guided Reading, Shared Writing, and Interactive Writing appropriately in classroom situations. Demonstration of how the difficulty level of teaching practice must change over time as students move from dependence on assistance to independence during the reading and writing processes. *Preq:* READ 860 or equivalent and 871.
- READ 873 Models for Balanced Literacy 3(3,0)** Prepares classroom teachers to organize K–5 classrooms for balanced literacy instruction. Participants apply classroom organization procedures in actual K–5 classrooms. *Preq:* READ 860 or equivalent, 865, and 872.
- READ 874 Principles and Strategies for Teaching English Speakers of Other Languages 3(3,0)** Helps participants develop culturally and linguistically responsive classrooms with instructional strategies for teaching the language acquisition process within the context of academics supportive of English language learners (ELLs) and their learning needs. *Preq:* Graduate standing in Education or consent of instructor.
- READ 880 Reading Recovery Teacher I 3(3,0)** First in a two-semester, two-course sequence designed to prepare teachers to implement and teach a Reading Recovery Program. Issues related to reading theory and process, instructional processes, program implementation, and evaluation. *Preq:* Consent of instructor. *Coreq:* READ 882.
- READ 881 Reading Recovery Teacher II 3(3,0)** Second in a two-course sequence designed to prepare teachers to implement and teach in a Reading Recovery Program. Issues related to reading theory and process, instructional process, program implementation, and evaluation. *Preq:* Admission into the Clemson Reading Recovery Program, READ 880, 882. *Coreq:* READ 883.
- READ 882 Reading Recovery Teacher Practicum I 3(0,9)** Teaching experience allowing teachers to develop and practice responsibilities of implementing and teaching first grade children in a Reading Recovery program. Participants implement content studied in READ 880. *Preq:* Consent of instructor. *Coreq:* READ 880.
- READ 883 Reading Recovery Teacher Practicum II 3(0,9)** Teaching experience and practice in implementing and teaching in a Reading Recovery Program. Participants implement content studied in READ 881. *Preq:* Admission into the Clemson University Reading Recovery Program, READ 880, 882. *Coreq:* READ 881.
- READ 884 Reading Recovery Clinical I 3(3,0)** First in a two-course sequence aimed at providing leadership experiences in implementing a Reading Recovery Program in an elementary school setting. *Preq:* Admission into the Clemson University Reading Recovery Teacher Leader program. *Coreq:* READ 886, 937.
- READ 885 Reading Recovery Clinical II 3(3,0)** Second in a two-course sequence to provide leadership experiences in implementing a Reading Recovery Program in an elementary school setting. *Preq:* Admission into the Clemson University Reading Recovery Teacher Leader program. *Coreq:* READ 887, 938.
- READ 886 Reading Recovery Teacher Leader Practicum I 3(0,9)** First in a two-course sequence designed to prepare Reading Recovery Teacher Leaders to implement a school-based program, supervise teachers, and carry out responsibilities related to maintaining a Reading Recovery site. *Preq:* Admission into the Clemson University Reading Recovery Teacher Leader program. *Coreq:* READ 884, 937.
- READ 887 Reading Recovery Teacher Leader Practicum II 3(0,9)** Second in a two-course sequence designed to prepare Reading Recovery Teacher Leaders to implement a school-based program, supervise teachers, and carry out responsibilities related to maintaining a Reading Recovery site. *Preq:* Admission into the Clemson University Reading Recovery Teacher Leader program. *Coreq:* READ 885, 938.
- READ 937 Reading Recovery Theory I 3(3,0)** First of a two-course sequence designed to examine theoretical principles of the reading process as applied in the Reading Recovery Program. Issues related to program implementation and systematic program changes. *Preq:* Consent of instructor. *Coreq:* READ 884, 886.
- READ 938 Reading Recovery Theory II 3(3,0)** Second of a two-course sequence designed to examine theoretical principles of the reading process as applied in the Reading Recovery program. Issues related to program implementation and systematic program changes. *Preq:* Consent of instructor. *Coreq:* READ 885, 887.
- READ 939 Theoretical Models of Reading 3(3,0)** Psychological basis of the reading process; principles applied in teaching reading. *Preq:* READ 860 or 861 or consent of instructor.
- READ 940 Advanced Diagnosis and Remediation in Reading 3(2,3)** Advanced diagnosis and remediation in reading; review of diagnostic instruments and instructional materials. *Preq:* READ 860 or 861; 865; or consent of instructor.
- READ 941 Advanced Practicum in Reading 3(2,3)** Diagnosis and remediation testing; remediation. Extensive case studies with recommendation for the classroom teacher are required. *Preq:* READ 940 and consent of instructor.
- READ 942 Teaching Reading Through a Literature Emphasis 3(3,0)** Strategies for integrating literature into the traditional reading program. *Preq:* An introductory reading class or equivalent.
- READ 943 The Reading-Writing Connection: An Integrated Approach 3(3,0)** Theoretical bases and practical techniques for teaching reading and writing in an integrated manner; reading and writing as processes; basic skills instruction in a coordinated program; multiple subject areas; use of student interest and ability. *Preq:* Basic reading methods course.
- READ 944 Reading Research: Review and Critique of the Literature 3(3,0)** Historical and contemporary research in reading and related literacy fields. *Preq:* Admission to the PhD program in Curriculum and Instruction.
- READ 945 Special Problems in Reading Education 3(1,4)** Individual study of a specific topic in reading. Students may choose from a large diversity of topics. *Preq:* READ 860 or 861; READ 862, 865, ED F 808; or consent of instructor.

REAL ESTATE DEVELOPMENT

- RED 800 Real Estate Development Process 3(3,0)** Real estate and land development processes from the developer's perspective. Cases and lectures are presented by leading experts in the development industry. Emphasizes participants of the development team and how to become a developer/"master builder" to create a superior built environment. *Preq:* Consent of instructor.
- RED 801 Real Estate Market Analysis 3(3,0)** Processes and data sources used to analyze the supply and demand for various building types. Explores demographic, technological, and economic trends affecting markets. General market analysis supply and demand approaches, including the use of GIS, are developed and applied primarily to residential, retail, and office markets at specific sites. *Preq:* Consent of instructor.
- RED 802 Real Estate Development Field Tour Seminar 3(0,9)** Examines the processes of creating quality development within the risk-reward framework focusing on design feasibility from the perspectives of the development team. Approximate two-week tour of the South Carolina Coast or other environs visits approximately forty developments and the key actors involved. To be taken Pass/Fail only. *Preq:* MRED student or consent of instructor.
- RED 803 Public-Private Partnership Development 3(3,0)** Focuses on public-private partnerships in the structuring, negotiating, and implementing the design, development, construction, and management of buildings and areas. Emphasis is on redevelopment/rehab and infill development; incentive tools and techniques, and market and feasibility issues for development within the risk-reward framework. *Preq:* RED 800 and consent of instructor.
- RED 804 Practicum in Residential and Master Planned/Resort Communities 3(3,0)** Exploration of the residential development process, especially for large-scale subdivisions and master planned/resort communities. Guest speakers, case studies, and field visits are used. Capstone preliminary feasibility analysis for a real world proposed development is completed by diverse student teams. *Preq:* Consent of instructor.

RED 805 Practicum in Commercial Development 3(3,0) Exploration of the commercial development process, especially for office and retail properties. Guest speakers, case studies, and field visits are used. Capstone preliminary feasibility analysis is completed by diverse student teams for a real world proposed development. *Preq:* Consent of instructor.

RED 810 Real Estate Seminar Roundtable 1(1,0) Weekly course which brings students and premier real estate professionals together through on-site or videoconference sessions. Presentations and discussions occur regarding cutting-edge projects and industry issues from around the country and internationally. May be repeated for a maximum of two credits. To be taken Pass/Fail only. *Preq:* Enrollment in MRED program or consent of instructor.

RED 811 Summer Internship in Real Estate Development 3(0,9) Preplanned, preapproved, faculty-supervised internship designed to give students on-the-job learning in support of classroom education. Internships must be no less than ten full-time, consecutive weeks with same internship provider. Ancillary study abroad experience or two, three-credit classes in place of internship requirement are possible with approval of MRED Director. To be taken Pass/Fail only.

RED 889 Selected Topics 3(3,0) Topics emphasizing current literature and results of current research. May be repeated for a maximum of nine credits, but only if different topics are covered. *Preq:* Consent of instructor.

RED 890 Directed Study 1-3(0,3-9) Students pursue individual professional interests under guidance of individual faculty as approved by MRED Director. Offered for elective credit for students in MRED program. May be repeated for a maximum of six credits.

RELIGION

REL 601 Studies in Biblical Literature and Religion 3(3,0) Critical examination of a selected topic in biblical studies. Topics vary from year to year. May be repeated once for credit. *Preq:* Consent of instructor.

REL 602 Studies in Religion 3(3,0) Thorough examination of a selected topic in one or more of the religious traditions of the world or of religious life in a particular region. Topics vary from year to year. May be repeated for a maximum of six credits. *Preq:* Consent of instructor.

REL 604 History of Early Christianity 3(3,0) Study of the history, social and doctrinal, of early Christianity up to 600 A.D. *Preq:* Consent of instructor.

REL 635 Religious Institutions in Community Life 3(3,0) Explores the particular significance of religious organizations as core institutions in American communities and examines their involvement with community political and social structures.

RHETORICS, COMMUNICATION, AND INFORMATION DESIGN

RCID 801 Histories of Rhetorics 3(3,0) Details historical beginnings from preplatonic, Sophists, Plato, Aristotle to early work of K. Burke (c. 1940). Attention is given to primary-secondary works, including historiographical principles of rhetorics, “the sister arts” (ut pictura poesis, ephrasis), and *techné* (as human faculty and mechanical technology). *Preq:* RCID major or consent of instructor.

RCID 802 Cultural Research Methods 3(3,0) Continuation of RCID 801, from 1940 to the present. Focuses on rhetorical inventions as traditional memory and innovative counter-memory. Includes such theorists as K. Burke, G. Ulmer, and P. Miller. Includes algorithmic, heuristic, aleatory procedures; classical, modern, postmodern topoi and ethnographies/grammatologies; gestural, oral (aural), literate, and electrate logics; graphic/filmic collage-montage; “rhythm science,” and sampling-remixing. *Preq:* RCID 801.

RCID 803 Empirical Research Methods 3(3,0) Study of assumptions-applications of empirical method in research. Includes sampling techniques, measurement, reliability, validity in collecting-analyzing data, using parametric-nonparametric statistical procedures. Considers approaches to content studies as well as survey and quasi-experimental research. Discusses philosophic writings of scholars such as Popper and Kuhn and content-specific work of Lazarsfeld, Lasswell, Hovland, among others. *Preq:* RCID major or consent of instructor.

RCID 804 Visual Rhetorics 3(3,0) Examines post-1945 modes of visual rhetoric and differing critical perspectives on their functions. Attention is given to key texts and visual creations to gain awareness of how visual codes operate in interior worlds and public life. Topics include the Challenge of Abstraction, Culture of Display, Body as Marketing Tool. *Preq:* RCID major or consent of instructor.

RCID 805 Rhetorics, Communication, Information Technologies 3(3,0) Hands-on examination of communication technologies used widely in academic and industry settings. Focuses on such intermedia as audio, video, Web, MOOs, Blogs, serious computer games, and all emerging technologies. *Preq:* RCID major or consent of instructor.

RCID 810 Pedagogy, Administration, and Assessment 3(3,0) Theory and praxis of professional communication in academic instruction and selected methods of pedagogical and programmatic assessment. Emphasizes communication-intermedia across the curriculum, academic program administration, and scholarship of teaching and learning. May be repeated for a maximum of six credits. *Preq:* RCID major or consent of instructor.

RCID 811 Perspectives in Information Designs 3(3,0) Offers multiple historical and theoretical perspectives for designing and presenting information in visual, oral, print, and digital media. Students apply humanistic-rhetorical models to these media and design multimedia projects that demonstrate transactions among theoretical perspectives. May include such models as homeostasis, autopoiesis, and virtuality. *Preq:* RCID major, RCID 801, or consent of instructor.

RCID 812 Cultural Critiques of Mechanical Reproductions 3(3,0) Study of critiques and ethics of simulation and sham realities, balanced with counter-critiques/counter-ethics. Considers the “death” of reality and the birth of third order “virtualities.” May include such theorists and commentators as Plato, W. Benjamin, M. Heidegger, J. Baudrillard, R. Barthes, P. Virilio, K. Hayles, A. Fausto-Sterling, F. Kittler, G. Deleuze, A. Ronell, M. Taylor. *Preq:* RCID major or consent of instructor.

RCID 813 Special Topics 3(3,0) Study of varying topics determined by such rubrics as history, method, criticism, place, time, subjectivity, models, memory, styles; or determined by such permutations and combinations of rubrics as ethos-gender-sex, theory-practice, rhetoric-poetics, politics-poetics, *techné*-technology, cultural-digital studies, analog-digital. May be repeated for a maximum of nine credits, but only if different topics are covered. *Preq:* RCID 802, 803, or consent of program director.

RCID 831 Independent Research and Study 3(3,0) Supervised reading in areas and concentrations where there is no comparable seminar or coursework. May be repeated for a maximum of nine credits. *Preq:* RCID 802, 803, 804, 805, five RCID cognate seminars, and consent of program director and chair of advisory committee.

RCID 833 Graduate Readings 3(3,0) Independent research/study focusing on preparation of dissertation project, with two support areas. May be repeated for a maximum of nine credits. *Preq:* RCID 802, 803, 804, 805, five RCID cognate seminars, and consent of program director and chair of advisory committee.

RCID 880 Applied Experience in Research and Communication in Studio 3(3,0) Students apply their seminar work systematically to individual research projects in a primary area and two support areas. Includes an introduction to applied research in a variety of places, both actual and virtual (archives, labs, studios), and to ever-changing notions of intellectual property and creative commons. May be repeated for a maximum of six credits. *Preq:* RCID 802, 803, 804, 805, four RCID cognate (elective) seminars.

RCID 991 Doctoral Dissertation Research 1-18

RURAL SOCIOLOGY

- R S (SOC) 601 Human Ecology 3(3,0)** Analysis of the interrelationships among the physical world, modifications in natural environments, human settlement patterns, and institutions that both encourage and regulate environmental modification. Emphasis is on conditions whereby natural resources become public policy concerns. Offered spring semester only. *Preq:* Junior standing or consent of instructor.
- R S (SOC) 659 The Community 3(3,0)** Close analysis of the development of contemporary communities and their place in society. Continuing effects of industrialization, migration, and technological change on community location and structure are examined. Structural relations of social class, status, and the associations among institutions are explored. *Preq:* Junior standing or consent of instructor.
- R S (SOC) 671 Demography 3(3,0)** See Soc 671.
- R S 881 Special Problems in Rural Social Research 1-3(0,2-6)** Recent research problems and literature emphasizing research design, analysis, theoretical generalizations, and application programs. May be repeated for a maximum of six credits. *Preq:* Six credit hours of 600-level sociology or rural sociology courses or consent of instructor.

SECONDARY EDUCATION

- EDSEC 637 Technology in Secondary Mathematics 3(3,0)** Students learn how to integrate calculators, data collectors, and computers in the secondary mathematics curriculum. They solve problems from middle school, Algebra I, Geometry, and Algebra II courses. *Preq:* Second semester Junior standing, admission to the professional level.
- EDSEC 765 Secondary School Curriculum 3(3,1)** Principles, techniques, and trends in secondary school curriculum development and evaluation.
- EDSEC 770 Science Laboratory and Field Instruction 3(3,0)** Methods of designing and conducting laboratory and field learning activities in secondary science courses. *Preq:* Undergraduate science teaching methods course or consent of instructor.
- EDSEC 803 Advanced Methods of Teaching in the Secondary School 3(3,1)** Principles and practices involved in promoting effective active learning in secondary schools.
- EDSEC 811 Middle Grades Language Arts Methods/Practicum 3(2,4)** Development of instructional practices appropriate for middle grades language arts teachers; familiarization with curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 812 Middle Grades Social Studies Methods/Practicum 3(2,4)** Development of instructional practices appropriate for middle grades social studies teachers; familiarization with curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 813 Middle Grades Math Methods/Practicum 3(2,4)** Development of instructional practices appropriate for middle grades mathematics teachers; familiarization with curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 814 Middle Grades Science Methods/Practicum 3(2,4)** Development of instructional practices appropriate for middle grades science teachers; familiarization with curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 821 Middle Grades Language Arts Methods/Student Teaching 3(2,4)** Continued development of instructional practices appropriate for middle grades language arts teachers; familiarization with additional curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 822 Middle Grades Social Studies Methods/Student Teaching 3(2,4)** Continued development of instructional practices appropriate for middle grades social studies teachers; familiarization with additional curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 823 Middle Grades Math Methods/Student Teaching 3(2,4)** Continued development of instructional practices appropriate for middle grades math teachers; familiarization with additional curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 824 Middle Grades Science Methods/Student Teaching 3(2,4)** Continued development of instructional practices appropriate for middle grades science teachers; familiarization with additional curriculum materials. Includes field work in local schools. *Preq:* Admission to MAT program.
- EDSEC 841 Advanced Studies in the Teaching of Secondary School English 3(3,1)** Methods of teaching secondary school English based on research and review of current literature. *Preq:* EDSEC 424 or equivalent, master's degree, or consent of instructor.
- EDSEC 842 Advanced Studies in the Teaching of Secondary School Mathematics 3(3,1)** Relationship between mathematics teaching theory and practice as shown in the research literature. Emphasis is on inquiry and other student-centered strategies. Issues and techniques in secondary mathematics. *Preq:* EDSEC 426 or equivalent, master's degree, or consent of instructor.
- EDSEC 843 Advanced Studies in the Teaching of Secondary School Science 3(3,1)** Methods of science teaching theory and practice as shown by current research literature. Emphasis is on laboratory, inquiry, and other student-centered teaching strategies. Techniques in science curriculum development. Issues in science teaching. Science teaching leadership skills. *Preq:* EDSEC 427 or equivalent, master's degree, or consent of instructor.
- EDSEC 844 Advanced Studies in the Teaching of Secondary School Social Studies 3(3,1)** Social studies teaching strategies derived from major theories of learning and contemporary research; curricular issues in social studies education. *Preq:* EDSEC 428 or equivalent, master's degree, or consent of instructor.
- EDSEC 846 Current Literature in English Education 3(3,1)** Research literature in English education; examination of literature in research methods and curriculum in English teaching. *Preq:* A methods course in English education.
- EDSEC 847 Current Literature in Mathematics Teaching 3(3,1)** Examination of literature in both the research and curriculum in mathematics education. *Preq:* A graduate teaching methods course or consent of instructor.
- EDSEC 848 Current Literature in Science Teaching 3(3,1)** Recent literature of science education; examination of literature in both the research and curriculum in secondary science teaching. *Preq:* A graduate teaching methods course or consent of instructor.
- EDSEC 849 Current Literature in Social Studies Teaching 3(3,1)** Examines recent literature in social studies education, in both curriculum and instruction. *Preq:* A graduate teaching methods course or consent of instructor.

SOCIOLOGY

- SOC (R S) 601 Human Ecology 3(3,0)** See R S 601.
- SOC 604 Sociological Theory 3(3,0)** Survey of the development of sociological theory. Required of all sociology majors. *Preq:* SOC 201 and Junior standing or consent of instructor.
- SOC 614 Policy and Social Change 3(3,0)** Uses the sociological perspective to examine policy development, implementation, and evaluation in the public and private sectors. Specifically, focuses on values and ethics and the effects of social change efforts on the outcomes of policy formation, social planning and implementation. *Preq:* SOC 201 and Junior standing or consent of instructor.
- SOC 633 Globalization and Social Change 3(3,0)** Examination of the social and historical causes of development and underdevelopment in societies. Various sociological theories of development are reviewed. Selected countries are examined in an international context. *Preq:* SOC 201 and Junior standing or consent of instructor.
- SOC 635 Leadership and Team Building 3(2,3)** Introduction to leadership and the process of building effective teams. Examines various sociological perspectives on leadership and their role in developing and maintaining various types of groups. Students are actively involved in the educational process through experiential learning opportunities. *Preq:* SOC 201 and Junior standing or consent of instructor.
- SOC (R S) 659 The Community 3(3,0)** See R S 659.
- SOC 660 Race, Ethnicity, and Class 3(3,0)** Investigation of sociological perspectives on race, ethnic relations, and social stratification. Analysis of the impact of social class on minority movements. *Preq:* SOC 201 and Junior standing or consent of instructor.
- SOC 663 Sociology of Parenting 3(3,0)** Sociology of parenting, child rearing, parenting styles, and outcomes; social change and parenting; variations by sex, race, and class; cross-cultural comparisons; research-based with applied orientation. *Preq:* SOC 201, Junior standing.

SOC (R S) 671 Demography 3(3,0) Demographic concepts, theory, and research methods for vital statistics, migration, and population distribution and projections. Collection and processing of demographic data and organization of demographic data systems. Offered fall semester only. *Preq:* ANTH 201 or R S 301 or SOC 201.

SOC 680 Medical Sociology 3(3,0) Sociocultural factors in the etiology and treatment of physical illness; medical occupations and professions; organization of health-care delivery systems. *Preq:* SOC 201 and Junior standing or consent of instructor.

SOC 681 Aging and Death 3(3,0) Sociological orientation to aging populations focusing on the impact of health care, welfare, and retirement systems. Includes dying as a social phenomenon, suicide, euthanasia, funerals. *Preq:* SOC 201 and Junior standing or consent of instructor.

SOC 684 Child Abuse and Treatment 3(3,0) Comprehensive examination of child abuse, neglect, and exploitation as major social problems; causes, effects, and prevalence of physical, sexual, and emotional maltreatment; definitional controversies; social policy and legal considerations; therapeutic approaches for children and their caretakers; child maltreatment and the judicial system. *Preq:* SOC 201 and Senior standing or consent of instructor.

SOC 693 Sociology of Corrections 3(3,0) Analysis of correctional alternatives. Topics include sentencing strategies and their impact, prison populations (male, female, and juvenile), inmate social structures, treatment and custody issues, community based alternatives (probation, parole, electronic monitoring, and work release), and correctional management issues. *Preq:* SOC 390 or consent of instructor.

SOC 694 Sociology of Organized Crimes 3(3,0) Examines the multifarious aspects of criminal organizations, namely their structure, methods, and networks. Specific topics may include white-collar crime and traditional, nontraditional, and transnational organized crime. *Preq:* SOC 201 or consent of instructor.

SOC 803 Survey Designs for Applied Social Research 4(3,2) Survey research design principles, procedures, and techniques used in applied sociology; instrumentation; data collection, management, and interpretation. Offered fall semester only. *Preq:* SOC (R S) 303 or equivalent.

SOC 805 Evaluation Research 3(3,0) Research methods and techniques of computer-assisted data management and analyses used in evaluating policies, operation, organization, and effectiveness of social programs in the private and public sectors; microcomputer software packages available for these purposes. Offered spring semester only. *Preq:* SOC 803.

SOC 807 Advanced Research Methods 3(3,0) Advanced methods in social research; measuring techniques and data analysis strategies; practical experience in various phases of social research. Offered spring semester only. *Preq:* SOC 803.

SOC 810 Theoretical Models in Applied Social Research 3(3,0) Comparative analysis of theoretical models in sociology and their uses in applied research; uses of these models in research concerned with the processes of industrial and economic growth and development. *Preq:* SOC 404 or equivalent.

SOC 830 Human Systems Development: Organizations and Society 3(3,0) Complex organizations such as human systems with primary focus on development and change, interorganizational relations and the influence of these structures on the community life. Offered fall semester only. *Preq:* SOC 430 or equivalent.

SOC 836 Environmental Sociology 3(2,3) Introduction to environmental sociology; relationship among human behavior, society, and the environment; focuses on the natural rather than the built environment; U.S. and global issues.

SOC 891 Master's Thesis Research 1-12

SOC 892 Selected Topics in Sociology 3(3,0) Current topics in applied sociology not covered in other graduate courses. May be repeated once for credit.

SOC 895 Field Experience 3-6 Supervised full-time work experience in a public agency or private enterprise to gain planning, research, and policy experience. May not be repeated for credit. To be taken Pass/Fail only. Offered summer session only. *Preq:* 12 hours of 800-level coursework in sociology.

SOC 896 Independent Study 1-3(1-3,0) Individual readings or research in a topic area selected according to a student's interests or program needs. May be repeated for a maximum of six credits. *Preq:* Approval of director of graduate studies.

SOC 897 Departmental Research and Professional Development Seminar 1(1,0) Presentation of current research by Department of Sociology faculty, staff, graduate students, and visiting researchers. Professional development seminars related to the research process, internships, and employment opportunities. May be repeated for a maximum of four credits. To be taken Pass/Fail only.

SOILS AND SUSTAINABLE CROP SYSTEMS

SSCS 645 Regulatory Issues and Policies 1(1,0) Introduction to regulations of agricultural practices and implementation of novel technologies and products. Emphasizes patenting biotechnology inventions and ethical issues. Includes survey of state and governmental agencies with responsibilities to avoid risk to humans, non-target organisms, and preservation of food safety, agricultural resources, and natural ecosystems.

SSCS 650 Agricultural Biosystems and Risk Assessment 1(1,0) In-depth discussion of recent articles on agricultural biotechnology and related issues. Independent and comprehensive literature survey and critical discussions on introduction of modified organisms into biological systems, agricultural adoption, and bio-risk assessment. Discussions relate to scientific discovery, application, and regulatory issues of agricultural biotechnology.

SSCS 651 Agricultural Biotechnology and Global Society 1(1,0) In-depth discussion of recent articles on agricultural biotechnology and related global issues. Includes independent and comprehensive literature survey and critical discussions on implementation of biotechnology products in the context of world agricultural production systems and economics. Discusses the role of international agencies and social and ethical issues.

SPANISH

SPAN 151 Spanish for Graduate Students 3(3,0) Intensive program only for graduate students preparing for the reading examination in Spanish. A minimum grade of B on final exam will satisfy Graduate School foreign language requirement. To be taken Pass/Fail only. May be repeated once. *Preq:* Graduate standing.

SPAN 699 Special Topics 3(3,0) Study of timely or special topics in Spanish. May be repeated for a maximum of six credits, but only if different topics are covered. *Preq:* Consent of department chair.

SPECIAL EDUCATION

ED SP 669 Characteristics of Individuals with Emotional and Behavioral Disorders 3(3,0) Addresses the characteristics of individuals with emotional and behavioral disorders. Consideration is given to historical and legal aspects, definitions, comprehensive assessment, and the impact of school, home, culture, and society on individuals with behavior disorders. Research findings in the field of behavior disorders are emphasized. *Preq:* ED SP 370.

ED SP 670 Characteristics of Individuals with Learning Disabilities 3(3,0) Provides specific knowledge of definitions, evaluation procedures, cognitive, social, academic, and functional skills of individuals with learning disabilities across the lifespan. *Preq:* ED SP 370.

ED SP 672 Characteristics of Individuals with Mental Retardation 3(3,0) Characteristics of mental retardation across the lifespan; learning, behavioral, and developmental aspects are examined. *Preq:* ED SP 370.

ED SP 673 Educational Procedures for Individuals with Mental Retardation 3(3,0) Identification, selection, and preparation of functional curriculum materials and pedagogy for teaching students with mental retardation. A multidisciplinary, student-centered approach to program planning provides the framework. *Preq:* ED SP 472.

ED SP 674 Procedures for Individuals with Emotional and Behavioral Disorders 3(3,0) Assists students in developing specific strategies for teaching individuals with emotional and behavioral disorders, utilizing preventive measures, expanding skills in behavior analysis, and implementing the least restrictive intervention warranted. Includes programmatic considerations, social skill instruction, curriculum selection, IEP development, and effective transition. *Preq:* ED SP 469.

ED SP 675 Educational Procedures for Individuals with Learning Disabilities 3(3,0) Provides knowledge of educational evaluation and instructional procedures to improve outcomes for individuals with learning disabilities. *Preq:* ED SP 470 or consent of instructor.

- ED SP 676 Practicum in Learning Disabilities 3(2,3)** Addresses content knowledge, skills, and professional values for successful teaching of students with learning disabilities. Focuses on teacher-directed instruction and the use of critical instructional factors, the use of recommended practices for individuals with learning disabilities, and the measurement and analysis of student performance data. *Preq:* ED SP 470, 475; completion of student teaching.
- ED SP 678 Practicum in Emotional and Behavioral Disorders 3(2,3)** Addresses content knowledge, performance skills, and professional values for successful teaching of students with emotional and behavioral disorders. Focuses on teacher-directed instruction and the use of critical instructional factors, the use of recommended practice for students with disabilities, and the measurement and analysis of student performance data. *Preq:* ED SP 474; completion of student teaching.
- ED SP 679 Practicum in Mental Retardation 3(2,3)** Addresses content knowledge, performance skills, and professional values for successful teaching of students with mental retardation. Focuses on teacher-directed instruction and the use of critical instructional factors, the use of recommended practices for students with disabilities, and the measurement and analysis of student performance data. *Preq:* ED SP 473; completion of student teaching.
- ED SP 738 Selected Topics in Special Education 1-3(1-3,0)** Specific master's-level special education topics not found in other courses are selected for in-depth study. May be repeated for a maximum of 24 credits, but only if different topics are covered.
- ED SP 739 Independent Study in Special Education 1-3(1-3,0)** Master's-level study of selected topics in special education under the direction of a faculty member. May be repeated for a maximum of 24 credits, but only if different topics are covered.
- ED SP 760 Social Development and Guidance of Young Children in Inclusive Settings 3(3,0)** Focuses on the social development and guidance of very young children—infants, toddlers, and preschoolers—in inclusive early childhood settings. Explores best practices for teachers of infants, toddlers, preschool, and primary age children in diverse education and care settings.
- ED SP 820 Language Arts Instruction for Individuals with Disabilities 3(3,1)** Research-based methods for instructing individuals with disabilities. Includes principles of effective language arts instruction in reading, writing, speaking, and listening skills. *Preq:* A course in reading methods or consent of instructor.
- ED SP 821 Educational Assessment of Individuals with Disabilities 3(3,1)** Introduction to the assessment process in special education by addressing procedural safeguards; data collection via informal and standardized procedures; issues in assessment; psychometric properties of standardized tests; and administration, scoring, and interpretation of selected instruments. *Preq:* ED SP 370 or consent of instructor.
- ED SP 822 Teaching Mathematics to Individuals with Disabilities 3(3,1)** Procedures for teaching mathematics to individuals with disabilities using direct instruction as an approach to assessment, instructional planning, and evaluation. Research in mathematics instruction for individuals with disabilities and mathematics program. *Preq:* ED SP 370 or consent of instructor.
- ED SP 823 Teaching Individuals with Disabilities in Integrated Settings 3(3,1)** Strategies for teaching individuals with disabilities in integrated settings; appropriate instruction, accommodations, natural supports, collaboration, and consultation. *Preq:* ED SP 370 or consent of instructor.
- ED SP 840 Transition Education and Services for Individuals with Disabilities 3(3,1)** Postsecondary options for individuals with disabilities; educational programs and services which support their transition from school to life. *Preq:* ED SP 370 or consent of instructor.
- ED SP 841 Instructional Strategies for Individuals with Disabilities in Secondary School Settings 3(3,1)** Instructional procedures for teaching individuals with disabilities in middle and high schools. Research-validated practices in learning strategies, content-area instruction, functional skills, and community-based instruction. *Preq:* ED SP 370 or consent of instructor.
- ED SP 853 Legal and Policy Issues in Special Education 3(3,1)** The impact of legislation-IDEA, Section 504 and litigation on special education; six major principles of special education law; interpretation of court cases; residential placements; discipline; extended school year services; compensatory education; inclusion; strategies to minimize litigation and trends in special education. *Preq:* ED SP 370 or consent of instructor.
- ED SP 854 Applied Behavior Analysis 3(3,1)** Class members accurately recognize, observe, record, and chart inappropriate behaviors; develop behavioral plans based on functional assessment data; determine behavioral objectives; apply behavior analysis principles; and foster student self-management skills. *Preq:* ED SP 370.
- ED SP (ED, ED F) 894 Directed Research 1-4(1-4,0)** See ED 894.
- ED SP 930 Critical Issues and Trends in Special Education 3(3,0)** Helps students develop an understanding of the role of convergent research evidence in addressing critical issues in special education practices and policies. Focuses on foundational issues of special education, intervention issues, and personnel preparation issues.
- ED SP 931 Advanced Research in Learning Disabilities 3(3,1)** Investigates history, theory, research, and practice pertaining to selected issues in methods and curriculum within the field of learning disabilities. Employs research-based interventions in the preparation, selection, and adaptation of instruction for students with learning disabilities. *Preq:* ED F 778 and ED SP 821 or consent of instructor.
- ED SP 932 Advanced Research in Emotional/Behavioral Disorders 3(3,1)** History, theory, research, and practice pertaining to selected issues in the fields of emotional/behavioral disorders. Influence of various theoretical approaches in the field. Research-based interventions and curriculum development. *Preq:* ED SP 821.
- ED SP 933 Advanced Research in Mental Retardation 3(3,0)** History, theory, research, and practice pertaining to selected issues in the field of mental retardation; historical treatment; theoretical approaches; research-based interventions; community-based and lifespan curriculum development for individuals with mental retardation. *Preq:* Graduate standing, ED SP 821.
- ED SP 934 Evidence-Based Research in Instructional Design and Delivery 3(3,0)** Emphasizes the research foundations of special education and the importance of evidence-based instructional design and delivery frameworks that impact important outcomes for students with disabilities.
- ED SP 935 Preparing Highly Qualified Special Educators: Research in Teacher Education 3(3,0)** Prepares doctoral students for the role of teacher educator. Topics include current issues in teacher education and special education including effective teaching practices in general and special education. Current findings in teacher education and special education research and development and conduct of research are emphasized. *Preq:* Curriculum and Instruction major or consent of instructor.
- ED SP 936 Single-Subject Research Design 3(3,0)** Provides doctoral students with practical information regarding the conduct, theory, and practice of single-subject research methods. Emphasizes skills in design, implementation, and analysis of single-subject research. *Preq:* Curriculum and Instruction major or consent of instructor.
- ED SP 937 Research in High Incidence Disabilities 3(3,0)** Emphasizes research related to characteristics and identification of individuals with high incidence disabilities, as well as evidence-based instructional and behavioral interventions. *Preq:* Curriculum and Instruction major or consent of instructor.
- ED SP (ED, ED F) 980 Internship in Curriculum and Instruction 1-6(0,3-18)** See ED 980.
- ED SP (ED, ED F) 991 Doctoral Dissertation Research 1-18** See ED 991.

TEXTILES

TEXT 616 Nonwoven Structures 3(2,2) Nonwoven fabric structures, their manufacture, properties, and applications. Methods of nonwoven fabric formation, resultant material characteristics and end-use applications are examined. *Preq:* TEXT 201.

TEXT 622 Properties of Textile Structures 3(2,2) Yarn and fabric properties, their scientific significance and analysis. Dimensional, structural, and mechanical interrelationships are established and evaluated.

TEXT 626 Instrumentation 3(3,0) Principles of industrial and process instrumentation and control as applied in the textile industry; static and dynamic characteristics of measurement devices; transducer principles and techniques of their application for measurement of physical properties such as pressure, temperature, flow, weight, etc.; principles of process controllers; applications of computers in textile process control.

TEXT 645 Special Topics in Textile, Fiber, and Polymer Science 1-3(1-3,0) Special topics in textile, fiber, and polymer sciences. A coenrollment course for similar courses in other departments, such as for those students involved in CAEFF projects and CH E 445. There may be different sections in a term to cover different topics. May be repeated for a maximum of nine credits, but only if different topics are covered. *Preq:* Consent of instructor.

TEXT 660 Textile Processes 3(3,0) Survey of machinery and processes of textile manufacturing from fiber formation through fabric finishing. For students with a nontextile background.

TEXT 672 Textile International Trade 3(3,0) Analyzes the current structure of the international textile trade including imports, exports, tariffs, and trade requirements. Field experience with local firms is used to enhance students' understanding. *Preq:* Senior standing or consent of instructor.

TEXT 675 Textile Marketing 3(3,0) Examination of the activities involved in the distribution of textile products in today's market. Emphasis is placed on the role of consumer research and the analysis of fashion in the design and promotion of textile products.

TEXT 821 Fiber Physics I 3(3,0) Fiber physical properties and their relationship to fiber structure; methods of investigating fiber structure and physical properties; theories of viscoelastic behavior and thermal properties; models of fiber structure. Offered fall semester only.

TEXT 822 Fiber Physics II 3(3,0) Extension of TEXT 821, providing a more in-depth study of the mathematics of polymer fiber viscoelasticity and the solid state thermodynamics of polymeric systems; properties of copolymers; polymer optical and electrical properties; radiation physics of polymers. Offered spring semester only. *Preq:* MTHSC 208 and TEXT 821 or consent of instructor.

TEXT 830 Textile Physics 3(3,0) Physical principles underlying manufacturing environments in which fibers, yarns, and fabrics are produced. Physical and mathematical techniques are developed for the study and analysis of the textile plant environment, controls, and energy requirements. Offered fall semester only.

TEXT 835 Textile Structures I 3(3,0) Pioneering works relating fiber properties to yarn properties; yarn geometry, fiber arrangements in twisted yarns, extension and breakage of continuous filament yarns, and deformation of staple fiber yarns.

TEXT 866 Fiber Formation 3(3,0) Formation of fibers by wet, dry, and melt spinning are studied in depth with emphasis on the rheology of solutions and melts, fiber structure, stretching and drawing processes, and the interrelationships of polymer properties and processes that determine fiber properties. Offered spring semester only.

TEXT 880 Selected Topics 3(3,0) Topics not covered in other textile chemistry or textile science courses.

TEXT 891 Master's Thesis Research 1-12

TEXT 991 Doctoral Dissertation Research 1-12

THEATRE

THEA (ENGL) 630 Dramatic Literature II 3(3,0) See ENGL 630.

THEA (ENGL) 647 Playwriting Workshop 3(0,3) Workshop in the creative writing of plays. May be repeated once. *Preq:* THEA (ENGL) 347 or consent of instructor.

THEA 672 Improvisation: Interpreting and Developing Texts 3(3,0) Practical applications using drama as a learning tool to strengthen writing skills, motivate collaboration, and heighten analytical skills. Students use improvisation to analyze texts and to revise original work, consider theory and research of contemporary scholars, and develop approaches to literature and composition based on readings and drama experiences. *Preq:* Senior standing or consent of instructor.

THEA 687 Stage Lighting I 3(2,1) Theory and practice of stage lighting through an understanding of various lighting instruments, lighting control systems, and execution of lighting designs.

THEA 697 Scene Painting 3(2,1) Practical study of basic painting techniques for the theatre including layout, proper use of materials, painting styles, and texturing techniques.

THEA 699 Independent Studies 1-3(1-3,0) Tutorial work for students with special interests outside the scope of existing courses. May be repeated for a maximum of six credits. *Preq:* Consent of department chair.

VOCATIONAL/TECHNICAL EDUCATION

VT ED 810 Foundations of Vocational and Technical Education 3(3,0) Evolution of vocational and technical education during the 20th century and current trends; sociological, psychological, and philosophical theories underlying current objectives; definition of broad parameters of the field.

VT ED 812 Vocational and Technical Program Finance 3(3,0) National, state, and local legislation governing financial support of vocational/technical programs; development of budget, audit, and financial administrative plans and systems. *Preq:* VT ED 810 and ED L 745 or equivalent.

VT ED 833 Curriculum Construction in Vocational and Technical Education 3(3,0) Students develop a specific course in a selected vocational and technical education area by specifying performance goals and building around these objectives. *Preq:* AG ED 640 or CTE 670 or equivalent.

VT ED 850 Programs, Concepts, and Issues in Vocational and Technical Education 3(3,0) Current activities and debates in vocational and technical education; traditional and innovative programs, career education, school finance, disadvantaged students, handicapped youth, sex equality, and other specialized programs.

VT ED 861 Administration and Supervision in Vocational and Technical Education 3(3,0) Principles and practices for administering and supervising vocational and technical schools and classes under federal vocational acts, state regulations, and local policies. *Preq:* VT ED 810 or consent of instructor.

VT ED 882 Seminar 1(1,0) Current issues and problems and proposed research projects.

VT ED 893 Advanced Research Design and Analysis 3(3,0) Emphasis on the dissertation from the proposal to the fully developed outline of all chapters. Required of all doctoral candidates in the vocational/technical education program. *Preq:* AG ED (CTE, ED) 889 or equivalent.

VT ED (ED L) 955 The Two-Year College 3(3,0) See ED L 955.

VT ED 980 Internship in Vocational/Technical Education 1-6 (0,3-18) Internship in which students gain experience working in a chosen area of specialization in vocational/technical education; field experience activities must be planned to build competence in the student's field of specialization. To be taken Pass/Fail only. *Preq:* Consent of the major advisor.

VT ED 991 Doctoral Dissertation Research 1-12

WILDLIFE AND FISHERIES BIOLOGY

W F B 610 Wildlife Management Techniques 3(1,6) Covers field and laboratory methods commonly used in wildlife management and research. Students interact with wildlife professionals. Topics include research methodology, estimating wildlife population characteristics, condition measures, and food habits; species determinations, sex and age, capture; population monitoring methods, GIS and mapping techniques, habitat evaluation and improvement. *Preq:* Junior standing; one year of general biology.

W F B 612 Wildlife Management 3(2,3) Basic principles and general practices of wildlife management and conservation are covered. Major problems concerning the management of wildlife resources, with emphasis on upland game species. Laboratory work includes practical work on the Clemson University woodlands and field trips to areas where wildlife management is being practiced.

W F B 614 Wildlife Nutritional Ecology 3(3,0) Concepts of how terrestrial wildlife obtains and utilizes energy and nutrients in wild ecosystems are taught. Energy and nutrient availability are discussed in the ecological context of distribution, flow, and cycling in natural and modified foraging areas. Physiology of digestion for major homeotherms. Offered spring semester only. *Preq:* FOR 415 or W F B 412.

W F B 616 Fishery Biology 3(2,3) Principles underlying freshwater fish production, major groups of freshwater fishes and their habitats. Topics include identification, age and growth, fecundity, food habits, populations estimation, environmental evaluation, management practices, and fish culture. *Preq:* One year of introductory biology, Junior standing.

W F B 630 Wildlife Conservation Policy 3(3,0)
Deals with the ecological rationale and management implications of public policy designed for the conservation of American wildlife resources. Emphasis is on managed-land issues. *Preq:* W F B 350 or consent of the instructor.

W F B 644 Wildlife Damage Management 3(2,3)
Covers the philosophical, sociological, ecological, and economic basis for controlling damage caused by animals problem wildlife populations. Emphasis is on fundamentals of prevention and control of damage caused by vertebrate species, especially mammals and birds. Includes interaction with federal and state agencies and private consultants. *Preq:* One year of introductory biology.

W F B 650 Aquaculture 3(3,0) Basic aquacultural techniques applied to freshwater and marine organisms; past and present culture of finfishes and shellfishes around the world; principles underlying fish production; water quality, feeding and nutrition as they influence production of cultured aquatic organisms. *Preq:* One year of general biology, Junior standing.

W F B 660 Warmwater Fish Diseases 2(2,0)
Study of diseases in warmwater fish including infectious and noninfectious processes. *Preq:* One year of general biology, Junior standing, consent of instructor.

W F B 662 Wetland Wildlife Biology 3(3,0)
Study of wetland wildlife habitats, emphasizing classification by physical, chemical, and biological characteristics; importance of wetland habitat for management and production of wetland wildlife species. Offered fall semester only. *Preq:* BIOL 104/106 or 111.

W F B (BIOSC, ENT) 669 Aquatic Insects 3(1,6) See ENT 669.

W F B 712 Wildlife Conservation for Teachers 2-3(2-3,0) Principles and practices of wildlife conservation providing an overview of wildlife diversity, ecology, and management in the state; population census, wildlife identification, capture and habitat management of game and nongame species. For in-service teachers only. *Preq:* Consent of instructor.

W F B 809 Seminar in Wildlife and Fisheries Science 1(1,0) Current literature and research in fisheries and wildlife sciences. At least one presentation is required. May be repeated for a maximum of four credits.

W F B 810 Publishing in Natural Resource Journals 2(2,0) Principles of preparing research manuscripts for publication in natural resource journals including searching the literature, communicating with editors, responding to reviews, publication ethics, and performing peer reviews. Offered spring semester of odd-numbered years only.

W F B 815 Principles of Wildlife Biology 3(2,3)
Theories and principles applicable to wildlife biology emphasizing upland game species. Offered fall semester of even-numbered years only.

W F B 818 Waterfowl Ecology and Management 3(2,3) Identification, ecology, and management of waterfowl. Laboratory work includes demonstration and application of relevant waterfowl management techniques, current literature topics, and field trips. Offered fall semester of odd-numbered years only. *Preq:* BIOSC 441 or W F B 412 or consent of instructor.

W F B 840 Fish Management 3(2,3) Principles and techniques of managing aquatic systems for recreational and/or commercial fishing, emphasizing streams, rivers, estuaries, and impoundments. Laboratory work includes demonstration and application of management techniques and field trips to observe management practices. Offered fall semester of odd-numbered years only. *Preq:* W F B 416 or consent of instructor.

W F B 860 Diagnostic Procedures of Warmwater Fish Diseases 2(1,2) Warmwater fish disease diagnostic procedures employing proper protocol to be followed by a fish disease diagnostician. Offered summer session of odd-numbered years only. *Coreq:* W F B 460 or consent of instructor.

W F B 861 Selected Topics 1-4(0-4,0-12) Current areas of aquaculture, fisheries, and wildlife management and research. May be repeated for credit. *Preq:* Consent of instructor.

W F B 863 Special Problems in Wildlife and Fisheries Biology 1-3(0,3-9) Research not related to a thesis. Credit varies with problems selected. *Preq:* Consent of instructor.

W F B 891 Master's Thesis Research 1-12

W F B 991 Doctoral Dissertaton Research 1-18

WOMEN'S STUDIES

W S 659 Selected Topics in Women's Studies 1-3(1-3,0) Topics change from semester to semester and are announced prior to registration. May be repeated for a maximum of six credits, but only if different topics are covered.